```python
In [11]:  import pandas as pd
          import numpy as np
          from statsmodels.tsa.stattools import adfuller
          import matplotlib.pyplot as plt
          import os
          from pmdarima import auto_arima
          import joblib  # For saving the model
```

```python
In [18]:  def get_csvs_from_dir(directory):
              try:
                  datasets_dir = os.path.join(directory, 'environment', 'datasets')
                  csv_files = [os.path.join(datasets_dir, file) for file in os.listdir(datasets_di
                  stock_names = [file.split("\\")[-1].split(".")[0] for file in csv_files]
                  return csv_files, stock_names
              except FileNotFoundError:
                  print(f"The directory {datasets_dir} does not exist.")
                  return [], []

          def load_data(file_path):
              df = pd.read_csv(file_path)
              df['datetime'] = pd.to_datetime(df['date'] + ' ' + df['time'])
              df.set_index('datetime', inplace=True)
              df = df['close'].resample('D').mean()
              df.interpolate(method='linear', inplace=True)
              return df


          def train_or_load_model(df, model_path):
              train = df['2002-01-01':'2015-12-31']
              test = df['2016-01-01':'2018-12-31']
              if os.path.exists(model_path):
                  model = joblib.load(model_path)
                  print(f'Model loaded from {model_path}')
              else:
                  model = auto_arima(train, seasonal=False, trace=True, error_action='ignore', sup
                  print(f'Best ARIMA model: {model.order}')
                  os.makedirs(os.path.dirname(model_path), exist_ok=True)
                  joblib.dump(model, model_path)
                  print(f'Model saved to {model_path}')

              return model, train, test

          def perform_forecasting(model, train, test, model_path):
              predictions = []
              history = train.copy()  # Start with the training data as history

              for t in test.index:
                  model = joblib.load(model_path)  # Load the model
                  model.update(test[t:t])  # Update the model with the latest available data
                  forecast = model.predict(n_periods=1)
                  predictions.append(forecast[0])
                  history = pd.concat([history, test[t:t]])

              return test, predictions


          def save_predictions(test, predictions, results_dir):
              results_path = os.path.join(results_dir, 'predictions.csv')
              if os.path.exists(results_path):
                  results_df = pd.read_csv(results_path)
                  results_df['arima'] = predictions
              else:
                  os.makedirs(os.path.dirname(results_path), exist_ok=True)
```

```python
        results_df = pd.DataFrame({'date': test.index, 'actual': test.values, 'arima': p
        results_df.to_csv(results_path, index=False)
        print(f"Predictions and actual prices updated in {results_path}")


    def plot_results(test, predictions):
        plt.figure(figsize=(14, 7))
        plt.plot(test, label='Actual')
        plt.plot(test.index, predictions, color='red', linestyle='--', label='Forecast')
        plt.title('Rolling Forecast AutoARIMA Model with Stationarity Checks')
        plt.xlabel('Date')
        plt.ylabel('Daily Close Price')
        plt.legend()
        plt.show()
```

In [19]:
```python
    def process_stocks(project_dir):
        datasets, stock_names = get_csvs_from_dir(project_dir)
        for file_path, stock_name in zip(datasets, stock_names):
            print(f"Processing {stock_name}...")
            results_dir = os.path.join(project_dir, 'agents', 'trained_models', stock_name)
            df = load_data(file_path)
            model_path = os.path.join(results_dir, 'arima_model.pkl')

            # Load or train a model, and get the train and test datasets
            model, train, test = train_or_load_model(df, model_path)

            # Perform forecasting
            test, predictions = perform_forecasting(model, train, test, model_path)

            # Save the forecast predictions
            save_predictions(test, predictions, results_dir)

            # Plot the results
            plot_results(test, predictions)

    if __name__ == '__main__':
        project_dir = os.path.dirname(os.path.dirname(os.getcwd()))
        process_stocks(project_dir)
```

```
Processing a...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=3636.153, Time=0.85 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=3716.198, Time=0.20 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=3630.197, Time=0.18 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=3631.785, Time=0.24 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=3715.021, Time=0.16 sec
 ARIMA(2,1,0)(0,0,0)[0] intercept   : AIC=3632.189, Time=0.30 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=3632.189, Time=0.27 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=3634.192, Time=0.56 sec
 ARIMA(1,1,0)(0,0,0)[0]             : AIC=3628.836, Time=0.07 sec
 ARIMA(2,1,0)(0,0,0)[0]             : AIC=3630.826, Time=0.14 sec
 ARIMA(1,1,1)(0,0,0)[0]             : AIC=3630.826, Time=0.12 sec
 ARIMA(0,1,1)(0,0,0)[0]             : AIC=3630.447, Time=0.11 sec
 ARIMA(2,1,1)(0,0,0)[0]             : AIC=3632.829, Time=0.35 sec

Best model:  ARIMA(1,1,0)(0,0,0)[0]
Total fit time: 3.547 seconds
Best ARIMA model: (1, 1, 0)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\a\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\a\predictions.csv
```
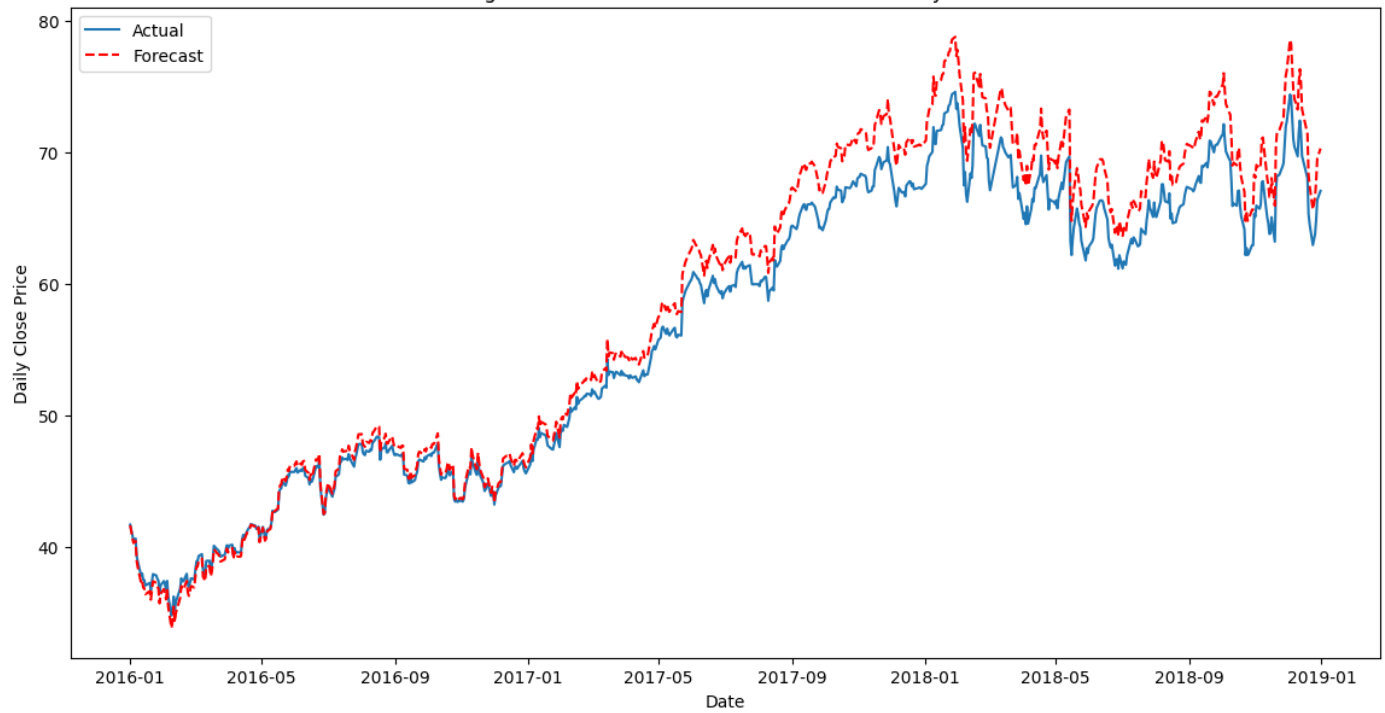
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing aapl...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=7954.453, Time=0.66 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=8273.796, Time=0.19 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=7953.000, Time=0.16 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=7964.456, Time=0.29 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=8280.804, Time=0.06 sec
 ARIMA(2,1,0)(0,0,0)[0] intercept   : AIC=7954.885, Time=0.19 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=7954.847, Time=0.48 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=7955.080, Time=1.01 sec
 ARIMA(1,1,0)(0,0,0)[0]             : AIC=7956.407, Time=0.07 sec

Best model:  ARIMA(1,1,0)(0,0,0)[0] intercept
Total fit time: 3.104 seconds
Best ARIMA model: (1, 1, 0)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\aapl\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\aapl\predictions.csv
```

Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing abc...
Performing stepwise search to minimize aic
 ARIMA(2,2,2)(0,0,0)[0] intercept   : AIC=inf, Time=2.92 sec
 ARIMA(0,2,0)(0,0,0)[0] intercept   : AIC=4781.013, Time=0.39 sec
 ARIMA(1,2,0)(0,0,0)[0] intercept   : AIC=4042.996, Time=0.15 sec
 ARIMA(0,2,1)(0,0,0)[0] intercept   : AIC=2900.895, Time=1.13 sec
 ARIMA(0,2,0)(0,0,0)[0]             : AIC=4779.013, Time=0.15 sec
 ARIMA(1,2,1)(0,0,0)[0] intercept   : AIC=inf, Time=2.42 sec
 ARIMA(0,2,2)(0,0,0)[0] intercept   : AIC=inf, Time=1.77 sec
 ARIMA(1,2,2)(0,0,0)[0] intercept   : AIC=inf, Time=3.31 sec
 ARIMA(0,2,1)(0,0,0)[0]             : AIC=2898.898, Time=0.24 sec
 ARIMA(1,2,1)(0,0,0)[0]             : AIC=inf, Time=0.51 sec
 ARIMA(0,2,2)(0,0,0)[0]             : AIC=inf, Time=0.54 sec
 ARIMA(1,2,0)(0,0,0)[0]             : AIC=4040.998, Time=0.09 sec
 ARIMA(1,2,2)(0,0,0)[0]             : AIC=inf, Time=0.96 sec

Best model:  ARIMA(0,2,1)(0,0,0)[0]
Total fit time: 14.588 seconds
Best ARIMA model: (0, 2, 1)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\abc\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\abc\predictions.csv
```
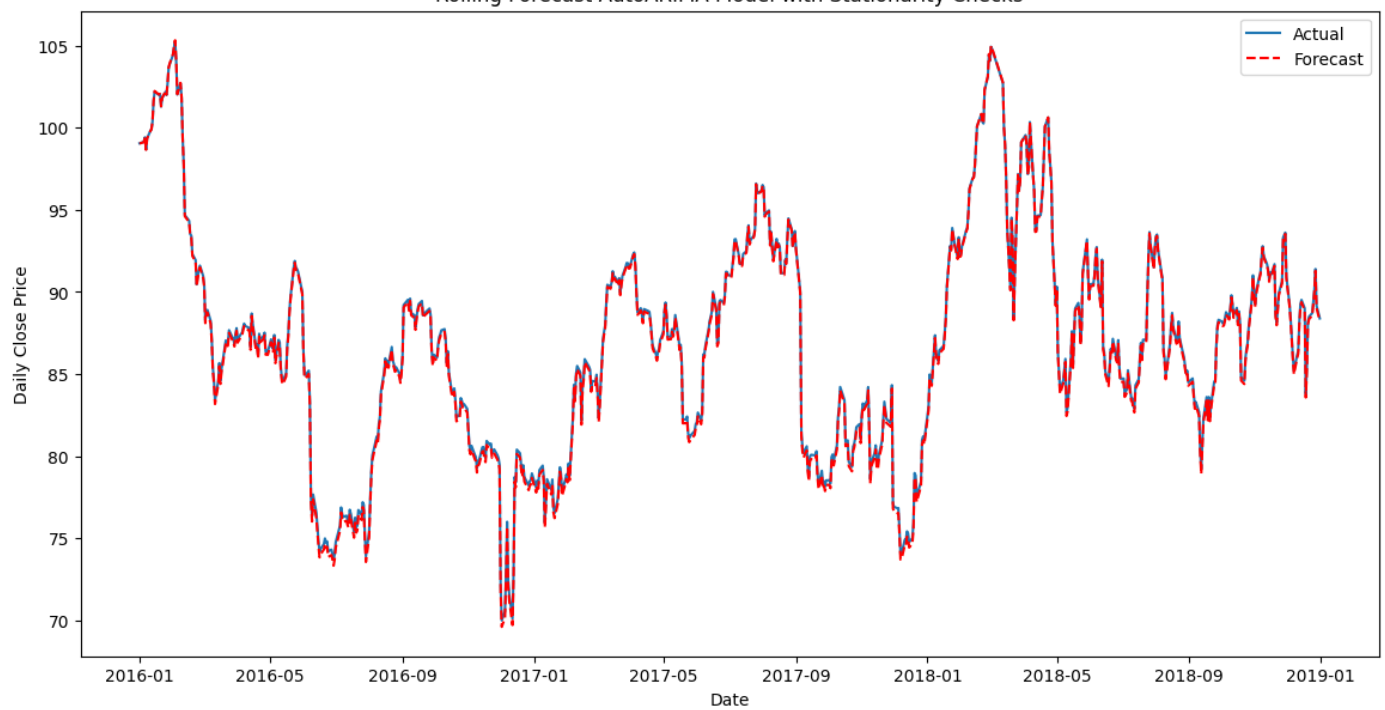
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing abt...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=-788.183, Time=2.92 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=-482.899, Time=0.36 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=-787.447, Time=0.16 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=-781.418, Time=0.27 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=-483.330, Time=0.13 sec
 ARIMA(1,1,2)(0,0,0)[0] intercept   : AIC=-785.214, Time=1.16 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=-786.381, Time=1.05 sec
 ARIMA(3,1,2)(0,0,0)[0] intercept   : AIC=-787.781, Time=3.46 sec
 ARIMA(2,1,3)(0,0,0)[0] intercept   : AIC=-792.300, Time=2.45 sec
 ARIMA(1,1,3)(0,0,0)[0] intercept   : AIC=-781.258, Time=1.09 sec
 ARIMA(3,1,3)(0,0,0)[0] intercept   : AIC=-791.976, Time=2.57 sec
 ARIMA(2,1,4)(0,0,0)[0] intercept   : AIC=-792.729, Time=3.94 sec
 ARIMA(1,1,4)(0,0,0)[0] intercept   : AIC=-793.052, Time=3.44 sec
 ARIMA(0,1,4)(0,0,0)[0] intercept   : AIC=-787.202, Time=0.78 sec
 ARIMA(1,1,5)(0,0,0)[0] intercept   : AIC=-792.663, Time=3.88 sec
 ARIMA(0,1,3)(0,0,0)[0] intercept   : AIC=-788.347, Time=0.58 sec
 ARIMA(0,1,5)(0,0,0)[0] intercept   : AIC=-789.802, Time=0.90 sec
 ARIMA(2,1,5)(0,0,0)[0] intercept   : AIC=-792.202, Time=5.01 sec
 ARIMA(1,1,4)(0,0,0)[0]             : AIC=-793.800, Time=0.78 sec
 ARIMA(0,1,4)(0,0,0)[0]             : AIC=-788.218, Time=0.37 sec
 ARIMA(1,1,3)(0,0,0)[0]             : AIC=-782.253, Time=0.33 sec
 ARIMA(2,1,4)(0,0,0)[0]             : AIC=-793.696, Time=1.63 sec
 ARIMA(1,1,5)(0,0,0)[0]             : AIC=-793.438, Time=0.96 sec
 ARIMA(0,1,3)(0,0,0)[0]             : AIC=-789.393, Time=0.21 sec
 ARIMA(0,1,5)(0,0,0)[0]             : AIC=-790.749, Time=0.37 sec
 ARIMA(2,1,3)(0,0,0)[0]             : AIC=-793.224, Time=0.72 sec
 ARIMA(2,1,5)(0,0,0)[0]             : AIC=-804.652, Time=2.70 sec
 ARIMA(3,1,5)(0,0,0)[0]             : AIC=-803.215, Time=2.98 sec
 ARIMA(3,1,4)(0,0,0)[0]             : AIC=-790.545, Time=2.07 sec

Best model:  ARIMA(2,1,5)(0,0,0)[0]
Total fit time: 47.345 seconds
Best ARIMA model: (2, 1, 5)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\abt\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\abt\predictions.csv
```
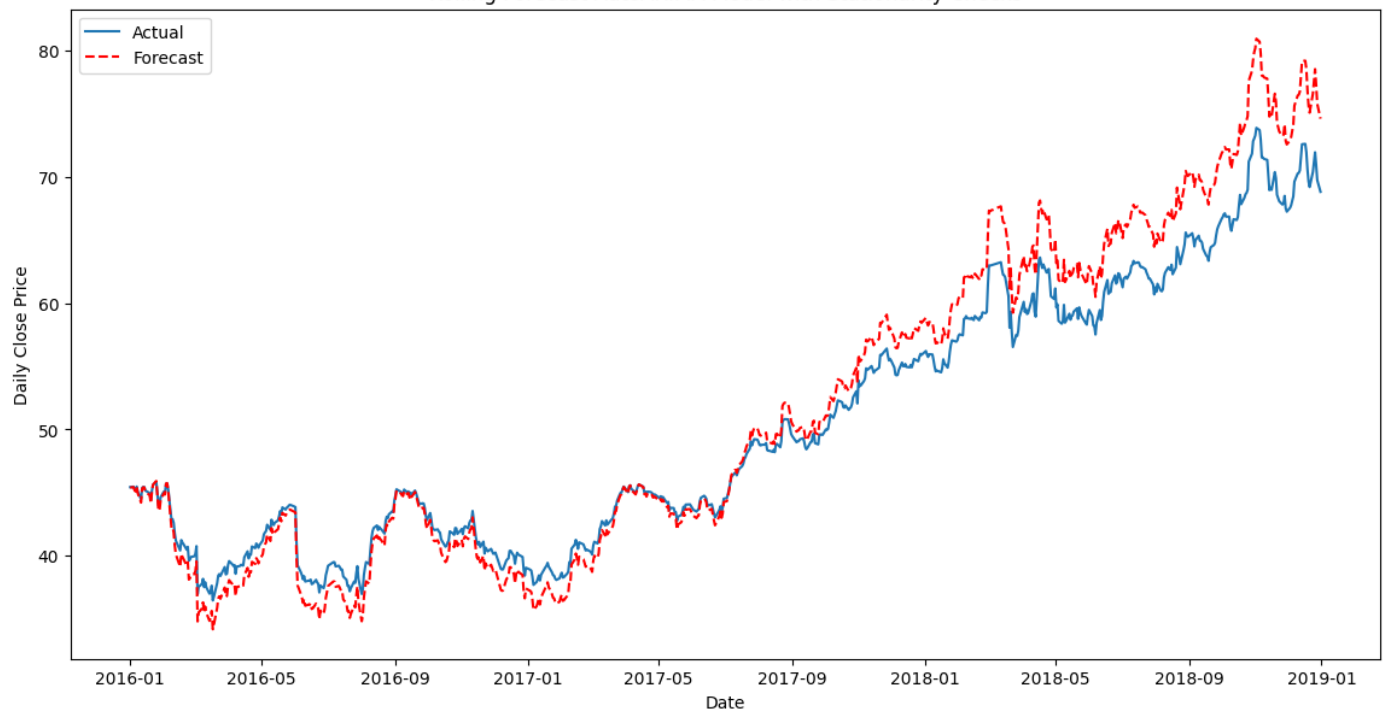
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing acn...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=6630.351, Time=2.57 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=6930.970, Time=0.36 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=6638.803, Time=0.14 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=6644.548, Time=0.23 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=6934.640, Time=0.08 sec
 ARIMA(1,1,2)(0,0,0)[0] intercept   : AIC=6641.103, Time=0.78 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=6628.356, Time=2.25 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=6639.112, Time=0.25 sec
 ARIMA(2,1,0)(0,0,0)[0] intercept   : AIC=6639.069, Time=0.27 sec
 ARIMA(3,1,1)(0,0,0)[0] intercept   : AIC=6643.060, Time=0.40 sec
 ARIMA(3,1,0)(0,0,0)[0] intercept   : AIC=6640.985, Time=0.29 sec
 ARIMA(3,1,2)(0,0,0)[0] intercept   : AIC=6629.937, Time=2.90 sec
 ARIMA(2,1,1)(0,0,0)[0]             : AIC=6632.421, Time=0.57 sec

Best model:  ARIMA(2,1,1)(0,0,0)[0] intercept
Total fit time: 11.097 seconds
Best ARIMA model: (2, 1, 1)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\acn\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\acn\predictions.csv
```
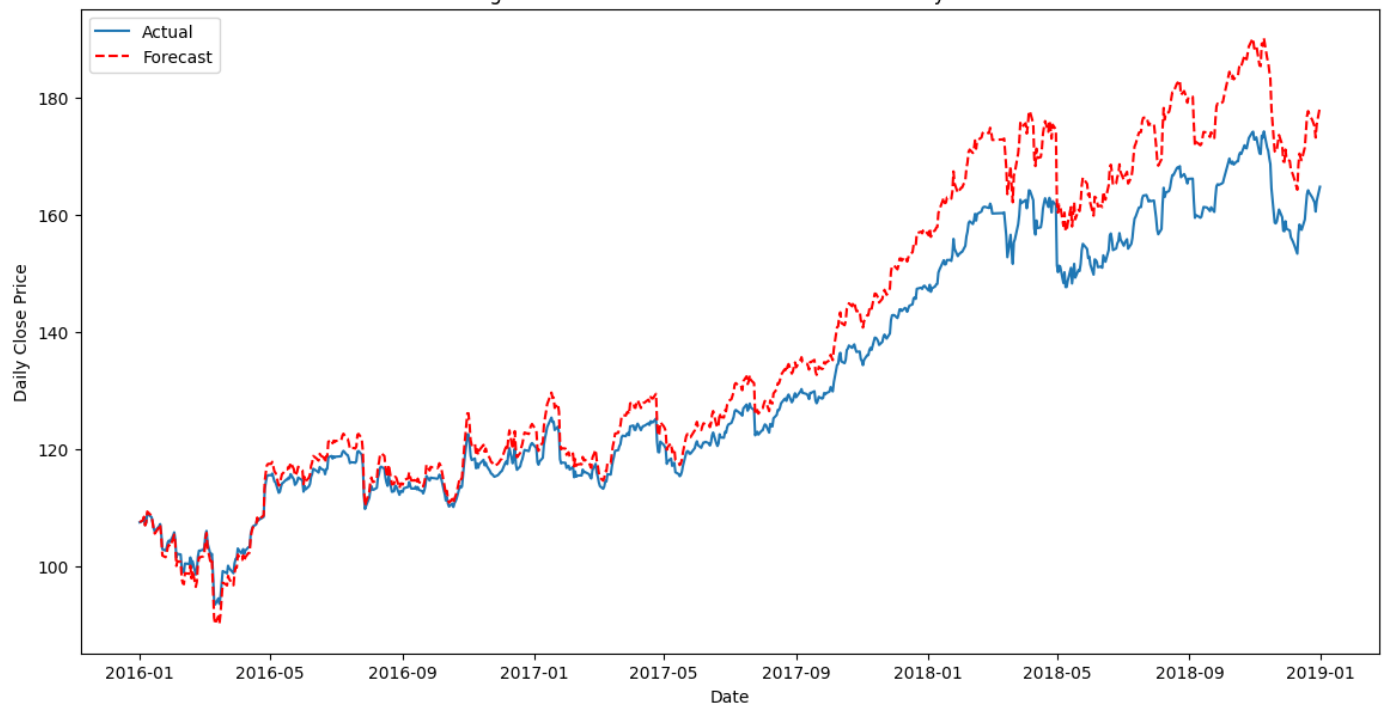
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing adbe...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=6253.461, Time=1.37 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=6552.401, Time=0.19 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=6255.132, Time=0.23 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=6255.581, Time=0.27 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=6555.829, Time=0.11 sec
 ARIMA(1,1,2)(0,0,0)[0] intercept   : AIC=6253.574, Time=0.93 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=6253.700, Time=1.07 sec
 ARIMA(3,1,2)(0,0,0)[0] intercept   : AIC=6252.853, Time=3.16 sec
 ARIMA(3,1,1)(0,0,0)[0] intercept   : AIC=6252.292, Time=0.56 sec
 ARIMA(3,1,0)(0,0,0)[0] intercept   : AIC=6250.617, Time=0.42 sec
 ARIMA(2,1,0)(0,0,0)[0] intercept   : AIC=6254.979, Time=0.37 sec
 ARIMA(4,1,0)(0,0,0)[0] intercept   : AIC=6251.780, Time=0.54 sec
 ARIMA(4,1,1)(0,0,0)[0] intercept   : AIC=6249.788, Time=2.92 sec
 ARIMA(5,1,1)(0,0,0)[0] intercept   : AIC=6250.779, Time=2.55 sec
 ARIMA(4,1,2)(0,0,0)[0] intercept   : AIC=6250.944, Time=4.08 sec
 ARIMA(5,1,0)(0,0,0)[0] intercept   : AIC=6249.870, Time=0.60 sec
 ARIMA(5,1,2)(0,0,0)[0] intercept   : AIC=6251.547, Time=3.13 sec
 ARIMA(4,1,1)(0,0,0)[0]             : AIC=6251.604, Time=1.14 sec

Best model:  ARIMA(4,1,1)(0,0,0)[0] intercept
Total fit time: 23.669 seconds
Best ARIMA model: (4, 1, 1)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\adbe\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\adbe\predictions.csv
```
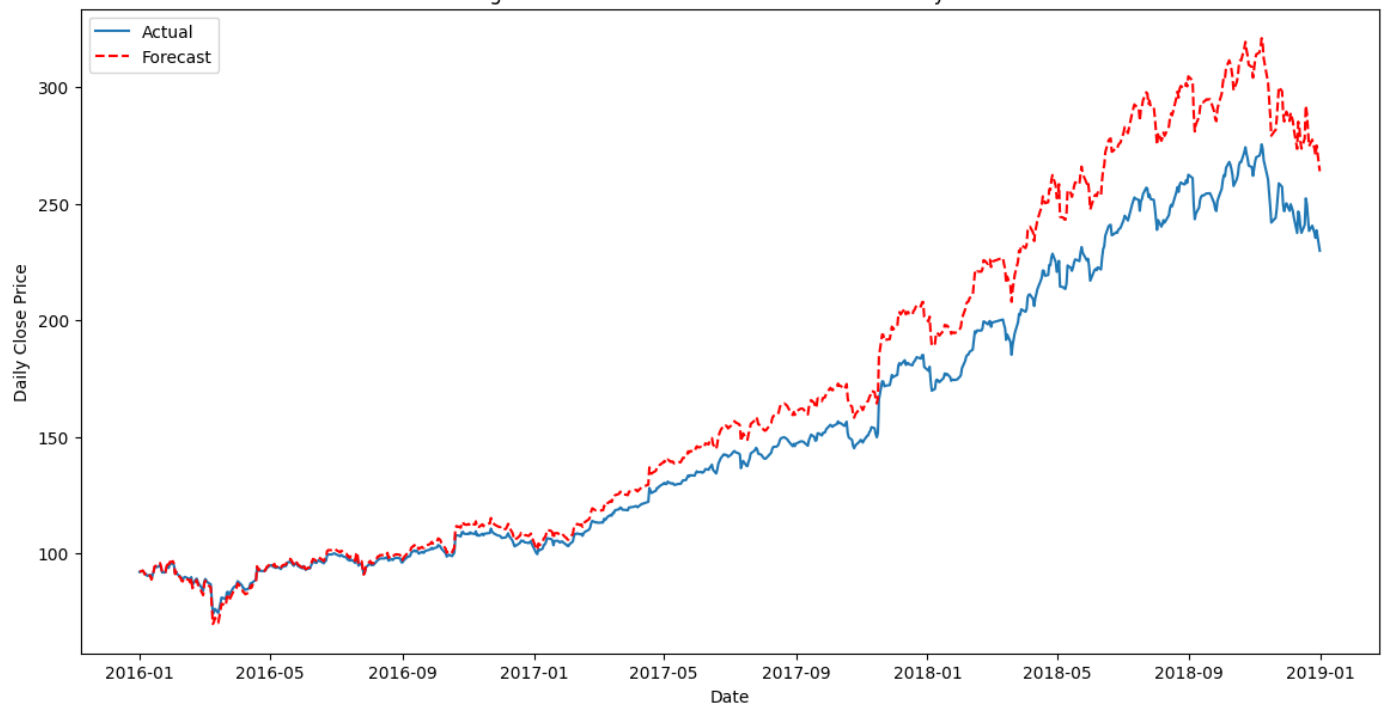
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing adi...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=7306.643, Time=0.85 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=7437.349, Time=0.39 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=7301.470, Time=0.22 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=7301.761, Time=0.25 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=7435.545, Time=0.07 sec
 ARIMA(2,1,0)(0,0,0)[0] intercept   : AIC=7302.776, Time=0.31 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=7302.731, Time=0.95 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=7304.659, Time=1.29 sec
 ARIMA(1,1,0)(0,0,0)[0]             : AIC=7299.623, Time=0.11 sec
 ARIMA(2,1,0)(0,0,0)[0]             : AIC=7300.932, Time=0.16 sec
 ARIMA(1,1,1)(0,0,0)[0]             : AIC=7300.887, Time=0.21 sec
 ARIMA(0,1,1)(0,0,0)[0]             : AIC=7299.920, Time=0.12 sec
 ARIMA(2,1,1)(0,0,0)[0]             : AIC=7302.815, Time=0.37 sec

Best model:  ARIMA(1,1,0)(0,0,0)[0]
Total fit time: 5.301 seconds
Best ARIMA model: (1, 1, 0)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\adi\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\adi\predictions.csv
```
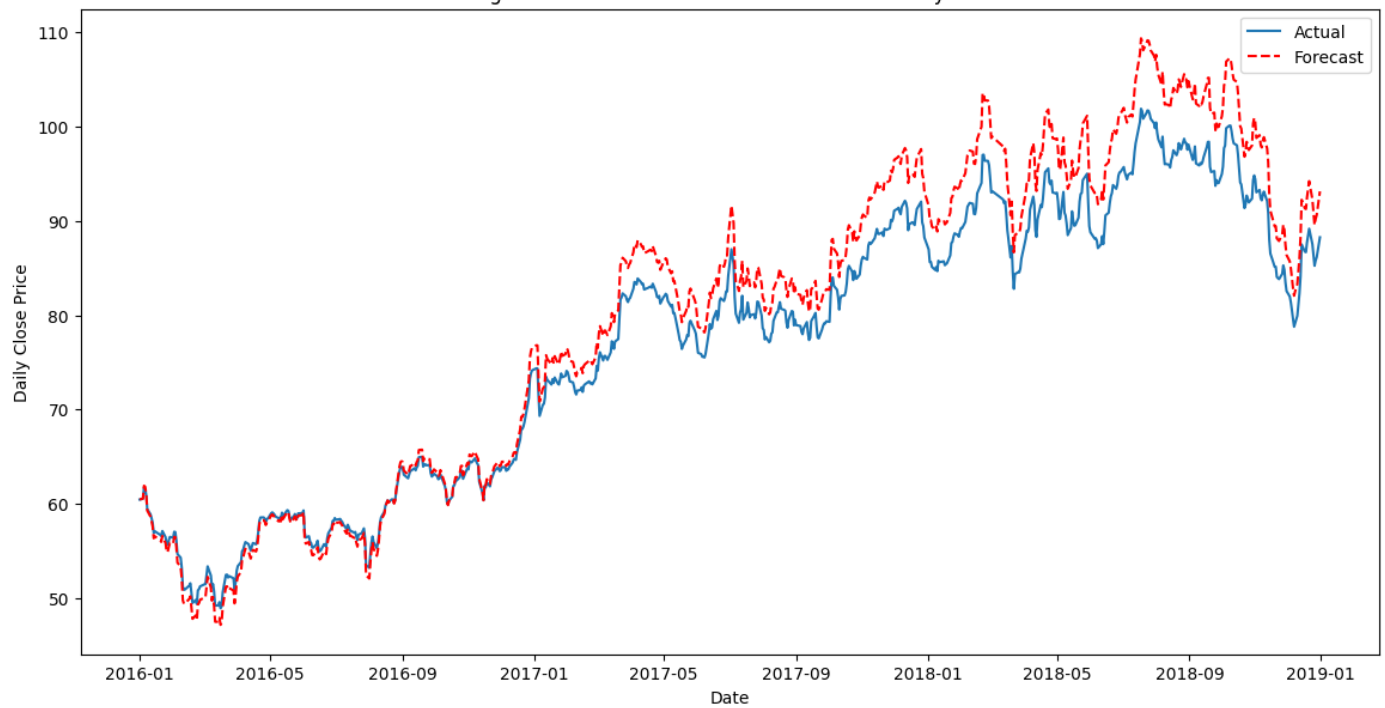
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing adm...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=4598.579, Time=1.61 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=4727.164, Time=0.21 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=4597.998, Time=0.14 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=4607.079, Time=0.25 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=4725.808, Time=0.10 sec
 ARIMA(2,1,0)(0,0,0)[0] intercept   : AIC=4596.457, Time=0.21 sec
 ARIMA(3,1,0)(0,0,0)[0] intercept   : AIC=4598.422, Time=0.30 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=4598.444, Time=0.87 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=4596.587, Time=0.61 sec
 ARIMA(3,1,1)(0,0,0)[0] intercept   : AIC=4600.373, Time=0.42 sec
 ARIMA(2,1,0)(0,0,0)[0]             : AIC=4594.896, Time=0.23 sec
 ARIMA(1,1,0)(0,0,0)[0]             : AIC=4596.461, Time=0.15 sec
 ARIMA(3,1,0)(0,0,0)[0]             : AIC=4596.857, Time=0.18 sec
 ARIMA(2,1,1)(0,0,0)[0]             : AIC=4596.881, Time=0.94 sec
 ARIMA(1,1,1)(0,0,0)[0]             : AIC=4595.023, Time=0.26 sec
 ARIMA(3,1,1)(0,0,0)[0]             : AIC=4597.793, Time=0.96 sec

Best model:  ARIMA(2,1,0)(0,0,0)[0]
Total fit time: 7.447 seconds
Best ARIMA model: (2, 1, 0)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\adm\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\adm\predictions.csv
```
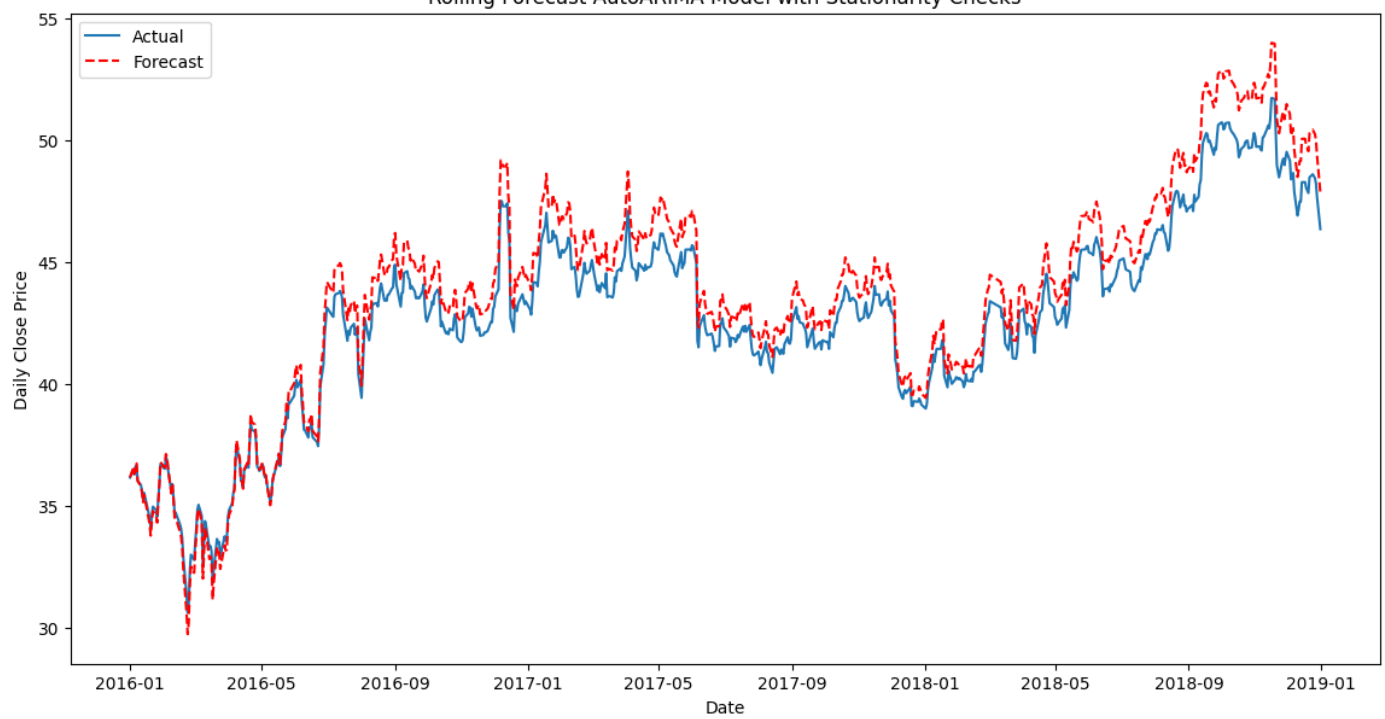
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing adp...
Performing stepwise search to minimize aic
 ARIMA(2,2,2)(0,0,0)[0] intercept   : AIC=inf, Time=2.60 sec
 ARIMA(0,2,0)(0,0,0)[0] intercept   : AIC=5811.225, Time=0.26 sec
 ARIMA(1,2,0)(0,0,0)[0] intercept   : AIC=5042.297, Time=0.18 sec
 ARIMA(0,2,1)(0,0,0)[0] intercept   : AIC=inf, Time=1.30 sec
 ARIMA(0,2,0)(0,0,0)[0]             : AIC=5809.226, Time=0.09 sec
 ARIMA(2,2,0)(0,0,0)[0] intercept   : AIC=4650.129, Time=0.24 sec
 ARIMA(3,2,0)(0,0,0)[0] intercept   : AIC=4424.663, Time=0.34 sec
 ARIMA(4,2,0)(0,0,0)[0] intercept   : AIC=4277.502, Time=0.61 sec
 ARIMA(5,2,0)(0,0,0)[0] intercept   : AIC=4179.694, Time=0.66 sec
 ARIMA(5,2,1)(0,0,0)[0] intercept   : AIC=inf, Time=5.08 sec
 ARIMA(4,2,1)(0,0,0)[0] intercept   : AIC=inf, Time=3.76 sec
 ARIMA(5,2,0)(0,0,0)[0]             : AIC=4177.696, Time=0.35 sec
 ARIMA(4,2,0)(0,0,0)[0]             : AIC=4275.503, Time=0.33 sec
 ARIMA(5,2,1)(0,0,0)[0]             : AIC=inf, Time=1.97 sec
 ARIMA(4,2,1)(0,0,0)[0]             : AIC=inf, Time=1.47 sec

Best model:  ARIMA(5,2,0)(0,0,0)[0]
Total fit time: 19.259 seconds
Best ARIMA model: (5, 2, 0)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\adp\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\adp\predictions.csv
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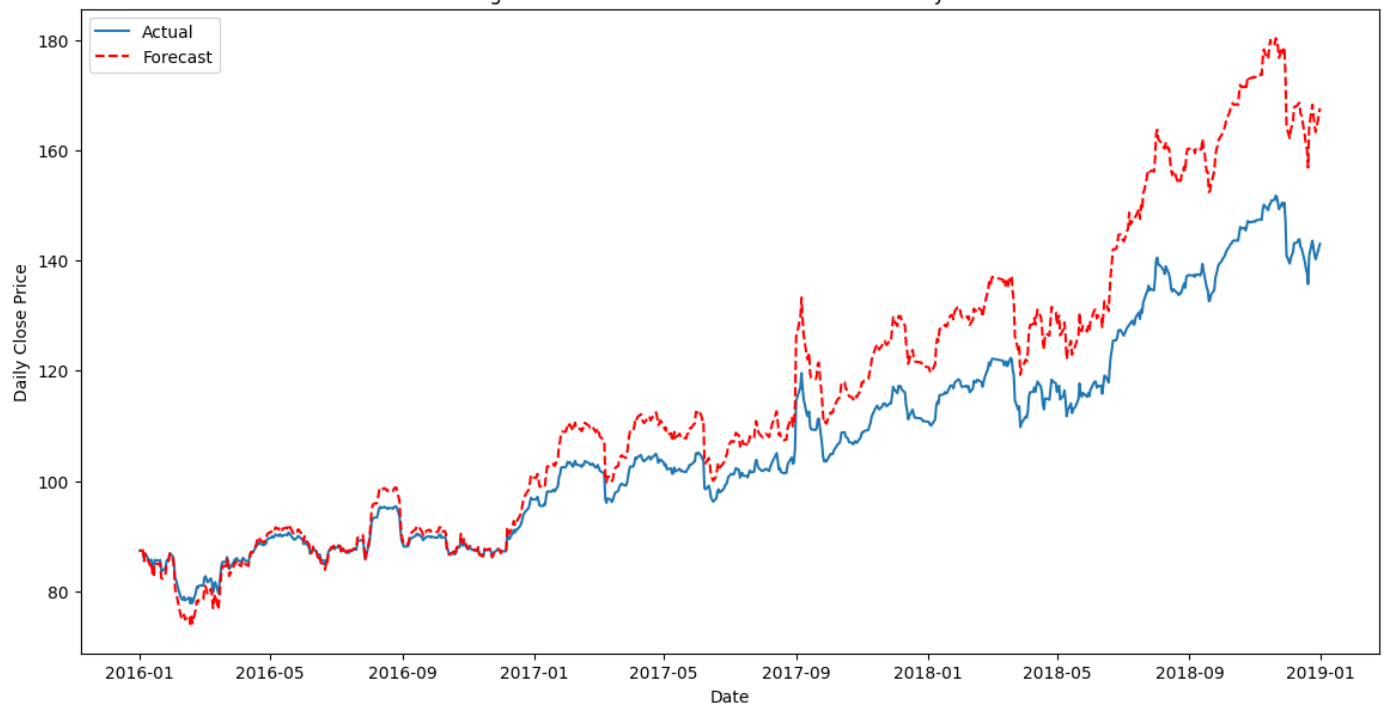
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing ads...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=17797.193, Time=0.60 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=18121.988, Time=0.05 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=17797.719, Time=0.13 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=17797.809, Time=0.25 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=18123.574, Time=0.05 sec
 ARIMA(1,1,2)(0,0,0)[0] intercept   : AIC=17793.772, Time=1.30 sec
 ARIMA(0,1,2)(0,0,0)[0] intercept   : AIC=17796.014, Time=0.31 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=17795.261, Time=0.37 sec
 ARIMA(1,1,3)(0,0,0)[0] intercept   : AIC=17795.321, Time=1.85 sec
 ARIMA(0,1,3)(0,0,0)[0] intercept   : AIC=17795.335, Time=0.31 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=17795.267, Time=0.73 sec
 ARIMA(2,1,3)(0,0,0)[0] intercept   : AIC=17797.771, Time=1.51 sec
 ARIMA(1,1,2)(0,0,0)[0]             : AIC=17793.631, Time=0.55 sec
 ARIMA(0,1,2)(0,0,0)[0]             : AIC=17796.357, Time=0.11 sec
 ARIMA(1,1,1)(0,0,0)[0]             : AIC=17795.564, Time=0.18 sec
 ARIMA(2,1,2)(0,0,0)[0]             : AIC=17797.427, Time=0.37 sec
 ARIMA(1,1,3)(0,0,0)[0]             : AIC=17795.158, Time=0.70 sec
 ARIMA(0,1,1)(0,0,0)[0]             : AIC=17798.274, Time=0.07 sec
 ARIMA(0,1,3)(0,0,0)[0]             : AIC=17795.580, Time=0.15 sec
 ARIMA(2,1,1)(0,0,0)[0]             : AIC=17795.526, Time=0.37 sec
 ARIMA(2,1,3)(0,0,0)[0]             : AIC=17797.631, Time=0.65 sec

Best model:  ARIMA(1,1,2)(0,0,0)[0]
Total fit time: 10.622 seconds
Best ARIMA model: (1, 1, 2)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\ads\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\ads\predictions.csv
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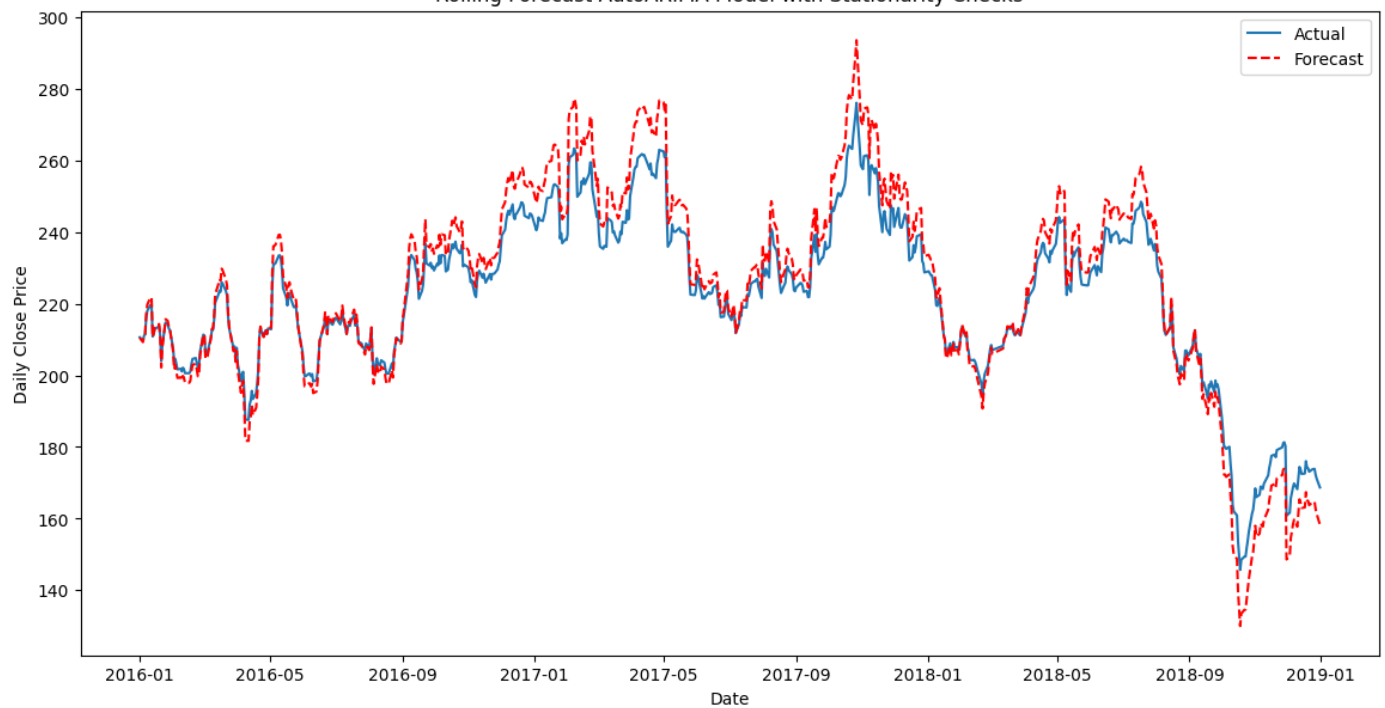
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing adsk...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=6262.064, Time=1.45 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=6761.885, Time=0.23 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=6272.018, Time=0.17 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=6267.884, Time=0.23 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=6762.463, Time=0.08 sec
 ARIMA(1,1,2)(0,0,0)[0] intercept   : AIC=6260.546, Time=0.34 sec
 ARIMA(0,1,2)(0,0,0)[0] intercept   : AIC=6262.942, Time=0.43 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=6261.454, Time=0.54 sec
 ARIMA(1,1,3)(0,0,0)[0] intercept   : AIC=6262.012, Time=2.19 sec
 ARIMA(0,1,3)(0,0,0)[0] intercept   : AIC=6260.682, Time=0.45 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=6261.198, Time=0.98 sec
 ARIMA(2,1,3)(0,0,0)[0] intercept   : AIC=6264.006, Time=4.10 sec
 ARIMA(1,1,2)(0,0,0)[0]             : AIC=6259.972, Time=0.21 sec
 ARIMA(0,1,2)(0,0,0)[0]             : AIC=6262.499, Time=0.16 sec
 ARIMA(1,1,1)(0,0,0)[0]             : AIC=6260.970, Time=0.19 sec
 ARIMA(2,1,2)(0,0,0)[0]             : AIC=6261.491, Time=0.63 sec
 ARIMA(1,1,3)(0,0,0)[0]             : AIC=6261.442, Time=0.73 sec
 ARIMA(0,1,1)(0,0,0)[0]             : AIC=6267.548, Time=0.11 sec
 ARIMA(0,1,3)(0,0,0)[0]             : AIC=6260.157, Time=0.21 sec
 ARIMA(2,1,1)(0,0,0)[0]             : AIC=6260.679, Time=0.42 sec
 ARIMA(2,1,3)(0,0,0)[0]             : AIC=6263.535, Time=0.91 sec

Best model:  ARIMA(1,1,2)(0,0,0)[0]
Total fit time: 14.760 seconds
Best ARIMA model: (1, 1, 2)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\adsk\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\adsk\predictions.csv
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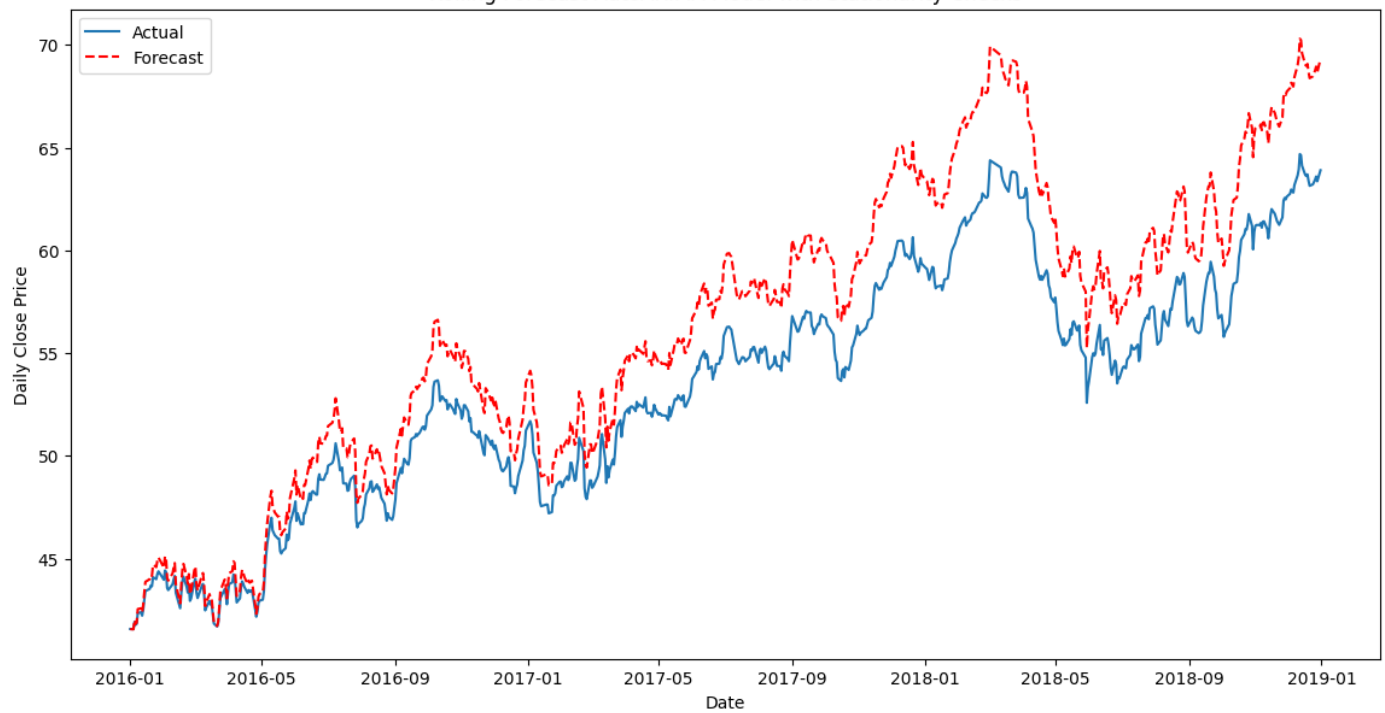
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing aee...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=2050.214, Time=2.11 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=2349.519, Time=0.34 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=2052.541, Time=0.43 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=2046.362, Time=0.26 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=2347.520, Time=0.16 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=2046.629, Time=0.48 sec
 ARIMA(0,1,2)(0,0,0)[0] intercept   : AIC=2046.782, Time=0.36 sec
 ARIMA(1,1,2)(0,0,0)[0] intercept   : AIC=2048.505, Time=1.26 sec
 ARIMA(0,1,1)(0,0,0)[0]             : AIC=2044.363, Time=0.25 sec
 ARIMA(1,1,1)(0,0,0)[0]             : AIC=2044.629, Time=0.39 sec
 ARIMA(0,1,2)(0,0,0)[0]             : AIC=2044.782, Time=0.18 sec
 ARIMA(1,1,0)(0,0,0)[0]             : AIC=2050.541, Time=0.07 sec
 ARIMA(1,1,2)(0,0,0)[0]             : AIC=2046.505, Time=0.84 sec

Best model:  ARIMA(0,1,1)(0,0,0)[0]
Total fit time: 7.129 seconds
Best ARIMA model: (0, 1, 1)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\aee\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\aee\predictions.csv
```

Rolling Forecast AutoARIMA Model with Stationarity Checks

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Processing aep...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=3050.368, Time=2.69 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=3455.222, Time=0.43 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=3056.643, Time=0.17 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=3060.921, Time=0.28 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=3453.470, Time=0.34 sec
 ARIMA(1,1,2)(0,0,0)[0] intercept   : AIC=3052.510, Time=1.36 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=3052.080, Time=1.17 sec
 ARIMA(3,1,2)(0,0,0)[0] intercept   : AIC=3034.955, Time=1.55 sec
 ARIMA(3,1,1)(0,0,0)[0] intercept   : AIC=3048.803, Time=1.17 sec
 ARIMA(4,1,2)(0,0,0)[0] intercept   : AIC=3036.429, Time=4.24 sec
 ARIMA(3,1,3)(0,0,0)[0] intercept   : AIC=3033.226, Time=3.07 sec
 ARIMA(2,1,3)(0,0,0)[0] intercept   : AIC=3040.158, Time=3.35 sec
 ARIMA(4,1,3)(0,0,0)[0] intercept   : AIC=3033.695, Time=4.02 sec
 ARIMA(3,1,4)(0,0,0)[0] intercept   : AIC=3035.986, Time=4.27 sec
 ARIMA(2,1,4)(0,0,0)[0] intercept   : AIC=3028.958, Time=4.39 sec
 ARIMA(1,1,4)(0,0,0)[0] intercept   : AIC=3035.807, Time=2.74 sec
 ARIMA(2,1,5)(0,0,0)[0] intercept   : AIC=3028.735, Time=5.21 sec
 ARIMA(1,1,5)(0,0,0)[0] intercept   : AIC=3032.684, Time=2.33 sec
 ARIMA(3,1,5)(0,0,0)[0] intercept   : AIC=3032.228, Time=4.50 sec
 ARIMA(2,1,5)(0,0,0)[0]             : AIC=3026.890, Time=2.55 sec
 ARIMA(1,1,5)(0,0,0)[0]             : AIC=3030.839, Time=1.09 sec
 ARIMA(2,1,4)(0,0,0)[0]             : AIC=3026.593, Time=2.09 sec
 ARIMA(1,1,4)(0,0,0)[0]             : AIC=3033.952, Time=1.25 sec
 ARIMA(2,1,3)(0,0,0)[0]             : AIC=3038.318, Time=2.16 sec
 ARIMA(3,1,4)(0,0,0)[0]             : AIC=3028.709, Time=2.32 sec
 ARIMA(1,1,3)(0,0,0)[0]             : AIC=3046.640, Time=0.80 sec
 ARIMA(3,1,3)(0,0,0)[0]             : AIC=3031.371, Time=1.22 sec
 ARIMA(3,1,5)(0,0,0)[0]             : AIC=3030.383, Time=2.00 sec

Best model:  ARIMA(2,1,4)(0,0,0)[0]
Total fit time: 62.752 seconds
Best ARIMA model: (2, 1, 4)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\aep\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\aep\predictions.csv
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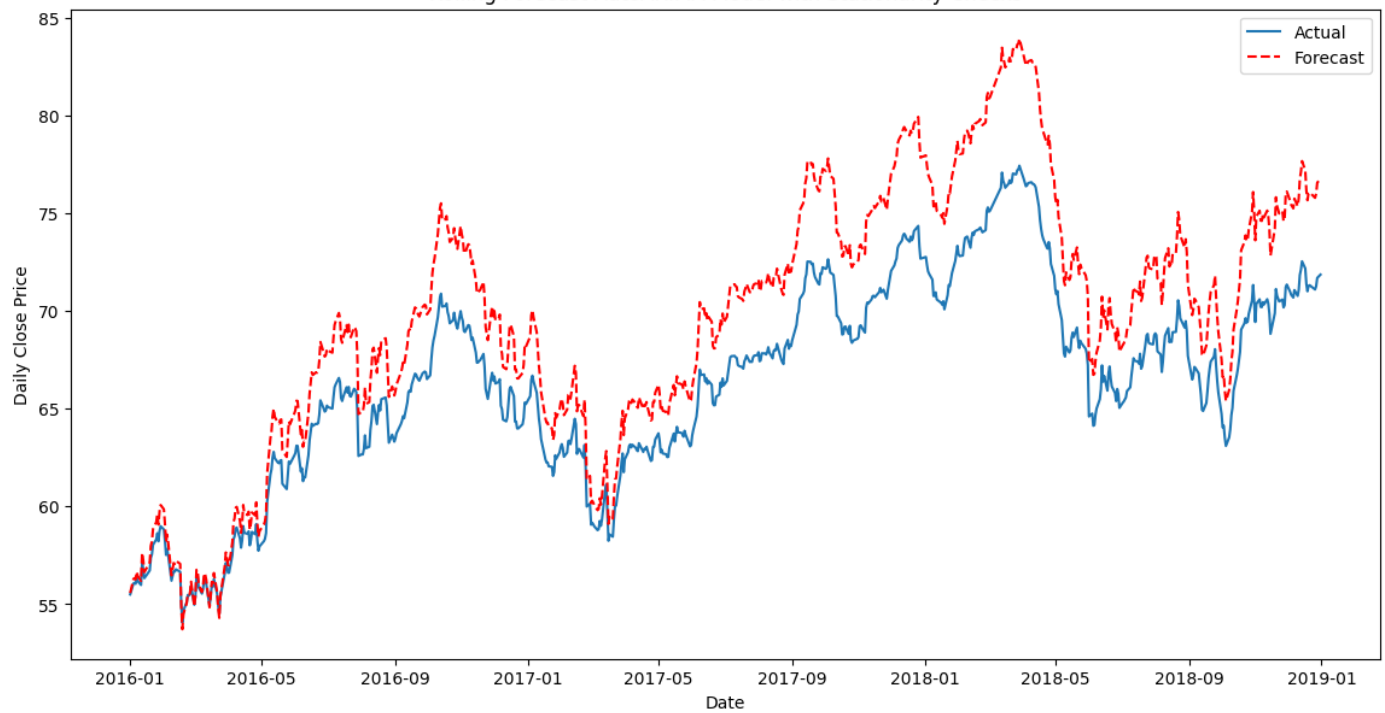
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing aes...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=-3471.009, Time=2.05 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=-3054.639, Time=0.20 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=-3469.863, Time=0.17 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=-3459.242, Time=0.28 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=-3056.404, Time=0.10 sec
 ARIMA(1,1,2)(0,0,0)[0] intercept   : AIC=-3472.684, Time=0.49 sec
 ARIMA(0,1,2)(0,0,0)[0] intercept   : AIC=-3467.136, Time=0.46 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=-3470.186, Time=0.62 sec
 ARIMA(1,1,3)(0,0,0)[0] intercept   : AIC=-3471.032, Time=1.72 sec
 ARIMA(0,1,3)(0,0,0)[0] intercept   : AIC=-3471.471, Time=0.62 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=-3470.185, Time=1.24 sec
 ARIMA(2,1,3)(0,0,0)[0] intercept   : AIC=-3470.248, Time=3.40 sec
 ARIMA(1,1,2)(0,0,0)[0]             : AIC=-3474.558, Time=0.22 sec
 ARIMA(0,1,2)(0,0,0)[0]             : AIC=-3468.990, Time=0.47 sec
 ARIMA(1,1,1)(0,0,0)[0]             : AIC=-3472.047, Time=0.33 sec
 ARIMA(2,1,2)(0,0,0)[0]             : AIC=-3472.881, Time=1.17 sec
 ARIMA(1,1,3)(0,0,0)[0]             : AIC=-3472.904, Time=0.91 sec
 ARIMA(0,1,1)(0,0,0)[0]             : AIC=-3461.083, Time=0.12 sec
 ARIMA(0,1,3)(0,0,0)[0]             : AIC=-3473.335, Time=0.24 sec
 ARIMA(2,1,1)(0,0,0)[0]             : AIC=-3472.048, Time=0.59 sec
 ARIMA(2,1,3)(0,0,0)[0]             : AIC=-3472.610, Time=1.64 sec

Best model:  ARIMA(1,1,2)(0,0,0)[0]
Total fit time: 17.042 seconds
Best ARIMA model: (1, 1, 2)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\aes\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\aes\predictions.csv
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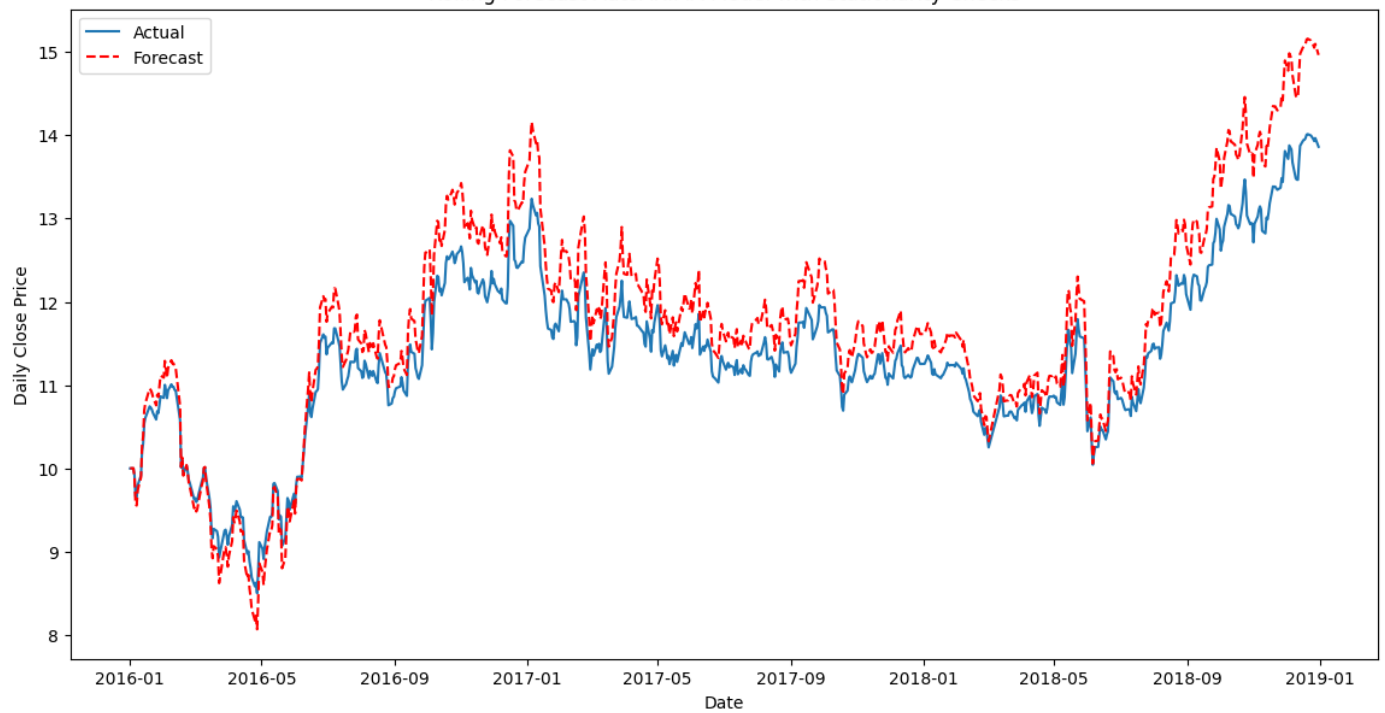
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing afl...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=1113.969, Time=1.54 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=1307.588, Time=0.21 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=1112.848, Time=0.14 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=1118.041, Time=0.25 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=1306.307, Time=0.15 sec
 ARIMA(2,1,0)(0,0,0)[0] intercept   : AIC=1114.838, Time=0.19 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=1114.833, Time=0.30 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=1116.830, Time=0.54 sec
 ARIMA(1,1,0)(0,0,0)[0]             : AIC=1111.332, Time=0.12 sec
 ARIMA(2,1,0)(0,0,0)[0]             : AIC=1113.320, Time=0.10 sec
 ARIMA(1,1,1)(0,0,0)[0]             : AIC=1113.314, Time=0.15 sec
 ARIMA(0,1,1)(0,0,0)[0]             : AIC=1116.565, Time=0.15 sec
 ARIMA(2,1,1)(0,0,0)[0]             : AIC=1114.267, Time=0.54 sec

Best model:  ARIMA(1,1,0)(0,0,0)[0]
Total fit time: 4.364 seconds
Best ARIMA model: (1, 1, 0)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\afl\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\afl\predictions.csv
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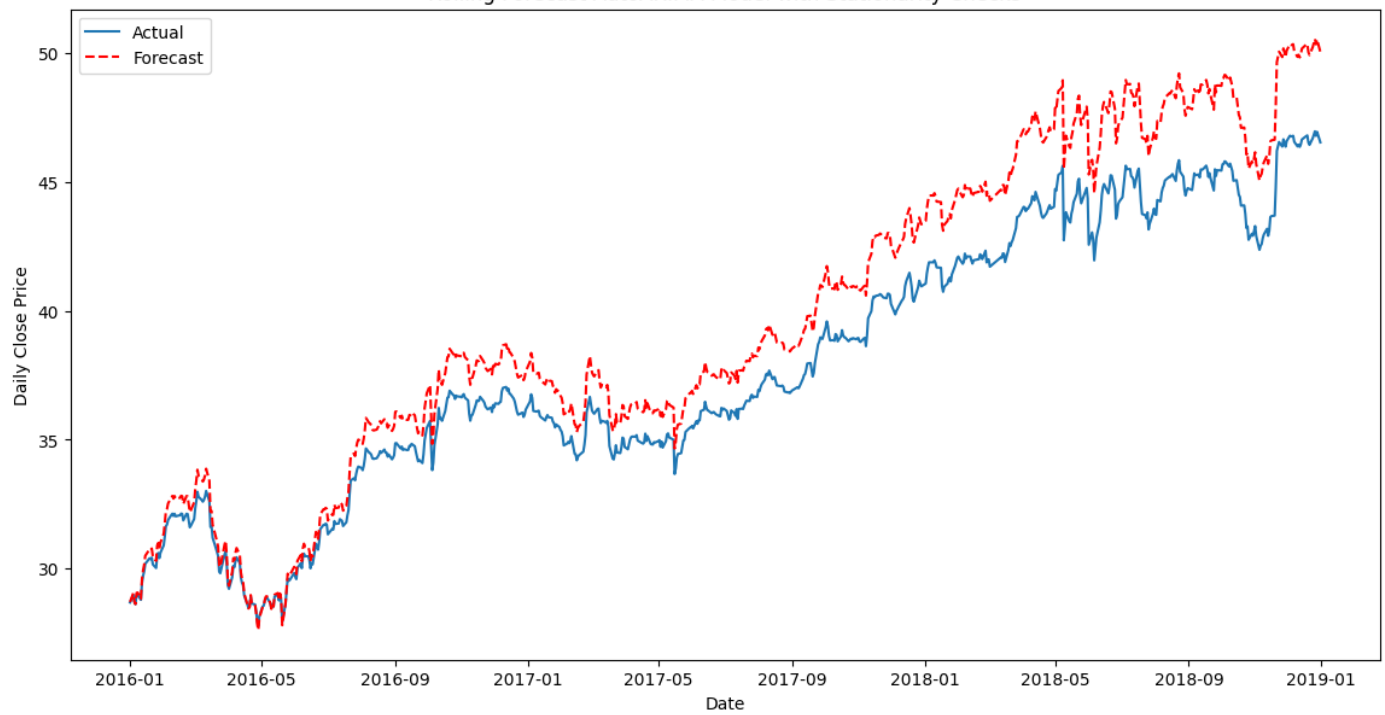
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing agn...
Performing stepwise search to minimize aic
 ARIMA(2,2,2)(0,0,0)[0] intercept   : AIC=inf, Time=2.45 sec
 ARIMA(0,2,0)(0,0,0)[0] intercept   : AIC=17088.655, Time=0.06 sec
 ARIMA(1,2,0)(0,0,0)[0] intercept   : AIC=16541.706, Time=0.17 sec
 ARIMA(0,2,1)(0,0,0)[0] intercept   : AIC=15534.990, Time=0.69 sec
 ARIMA(0,2,0)(0,0,0)[0]             : AIC=17086.694, Time=0.06 sec
 ARIMA(1,2,1)(0,0,0)[0] intercept   : AIC=inf, Time=1.72 sec
 ARIMA(0,2,2)(0,0,0)[0] intercept   : AIC=inf, Time=1.70 sec
 ARIMA(1,2,2)(0,0,0)[0] intercept   : AIC=inf, Time=2.83 sec
 ARIMA(0,2,1)(0,0,0)[0]             : AIC=inf, Time=0.22 sec

Best model:  ARIMA(0,2,1)(0,0,0)[0] intercept
Total fit time: 9.904 seconds
Best ARIMA model: (0, 2, 1)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\agn\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\agn\predictions.csv
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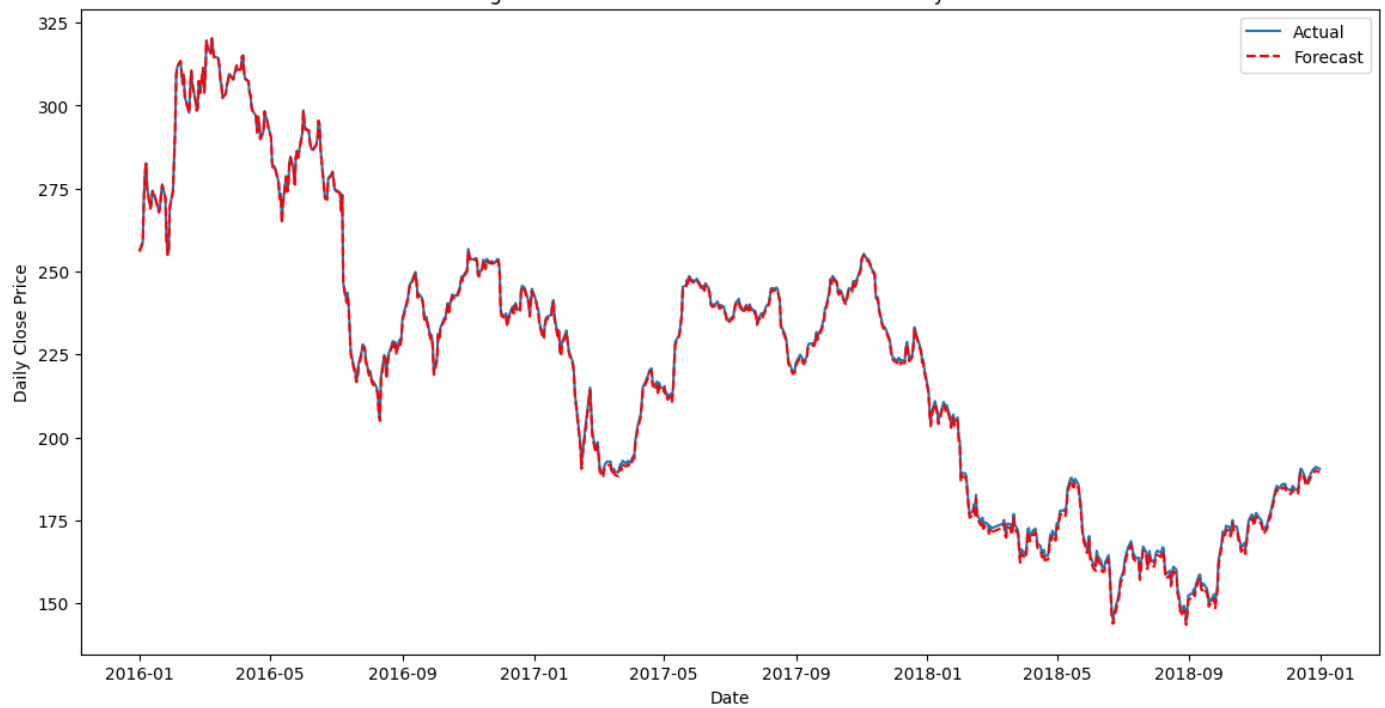
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing aig...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=37370.760, Time=1.56 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=37795.986, Time=0.06 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=37368.497, Time=0.24 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=37393.766, Time=0.41 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=37798.641, Time=0.05 sec
 ARIMA(2,1,0)(0,0,0)[0] intercept   : AIC=37370.497, Time=0.18 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=37370.497, Time=0.24 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=37371.900, Time=1.59 sec
 ARIMA(1,1,0)(0,0,0)[0]             : AIC=37369.117, Time=0.08 sec

Best model:  ARIMA(1,1,0)(0,0,0)[0] intercept
Total fit time: 4.402 seconds
Best ARIMA model: (1, 1, 0)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\aig\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\aig\predictions.csv
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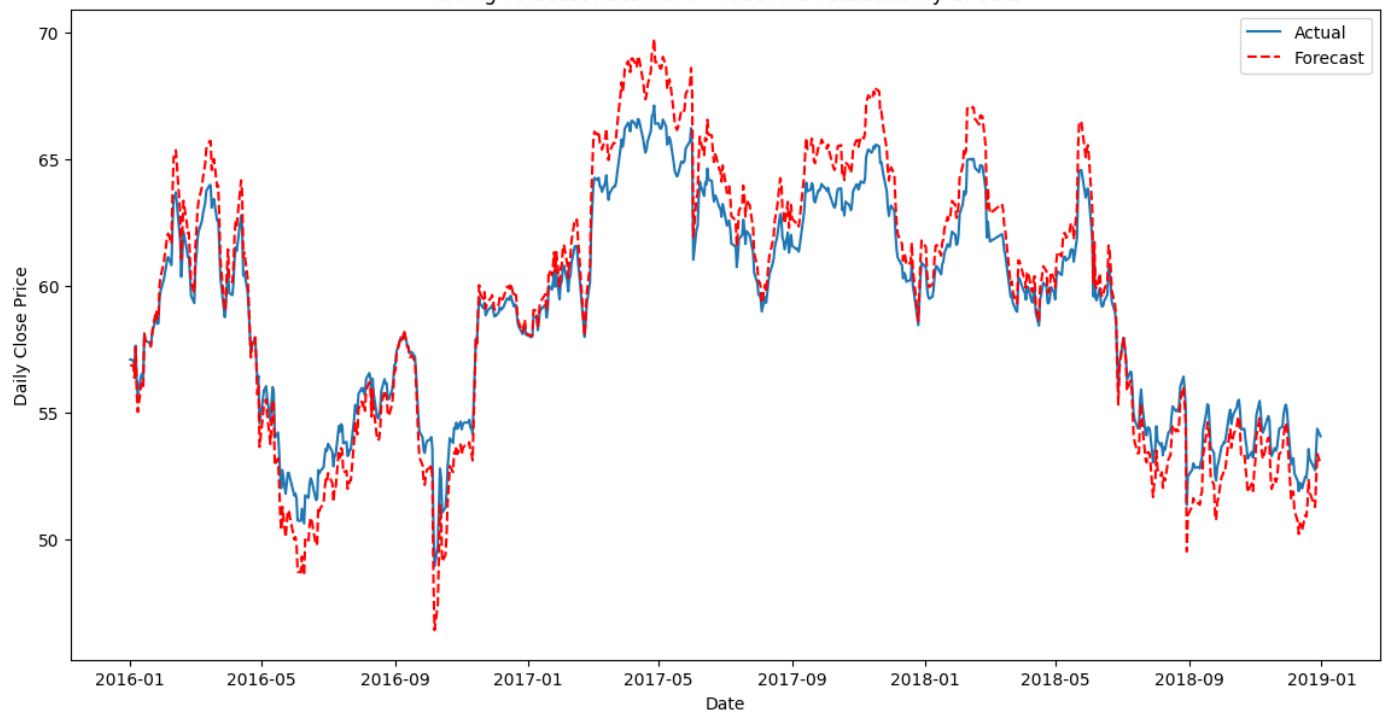
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing aiv...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=3461.034, Time=0.79 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=3889.166, Time=0.22 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=3463.305, Time=0.15 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=3481.094, Time=0.29 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=3887.181, Time=0.11 sec
 ARIMA(1,1,2)(0,0,0)[0] intercept   : AIC=3462.282, Time=0.90 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=3463.396, Time=1.24 sec
 ARIMA(3,1,2)(0,0,0)[0] intercept   : AIC=3451.885, Time=3.70 sec
 ARIMA(3,1,1)(0,0,0)[0] intercept   : AIC=3460.026, Time=1.05 sec
 ARIMA(4,1,2)(0,0,0)[0] intercept   : AIC=3463.163, Time=2.11 sec
 ARIMA(3,1,3)(0,0,0)[0] intercept   : AIC=3459.807, Time=3.54 sec
 ARIMA(2,1,3)(0,0,0)[0] intercept   : AIC=3461.528, Time=0.64 sec
 ARIMA(4,1,1)(0,0,0)[0] intercept   : AIC=3459.205, Time=2.46 sec
 ARIMA(4,1,3)(0,0,0)[0] intercept   : AIC=3461.261, Time=4.44 sec
 ARIMA(3,1,2)(0,0,0)[0]             : AIC=3449.886, Time=1.75 sec
 ARIMA(2,1,2)(0,0,0)[0]             : AIC=3459.043, Time=0.34 sec
 ARIMA(3,1,1)(0,0,0)[0]             : AIC=3458.034, Time=0.50 sec
 ARIMA(4,1,2)(0,0,0)[0]             : AIC=3461.171, Time=0.97 sec
 ARIMA(3,1,3)(0,0,0)[0]             : AIC=3457.023, Time=2.09 sec
 ARIMA(2,1,1)(0,0,0)[0]             : AIC=3461.406, Time=0.56 sec
 ARIMA(2,1,3)(0,0,0)[0]             : AIC=3459.536, Time=0.26 sec
 ARIMA(4,1,1)(0,0,0)[0]             : AIC=3457.215, Time=1.57 sec
 ARIMA(4,1,3)(0,0,0)[0]             : AIC=3454.146, Time=2.27 sec

Best model:  ARIMA(3,1,2)(0,0,0)[0]
Total fit time: 31.962 seconds
Best ARIMA model: (3, 1, 2)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\aiv\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\aiv\predictions.csv
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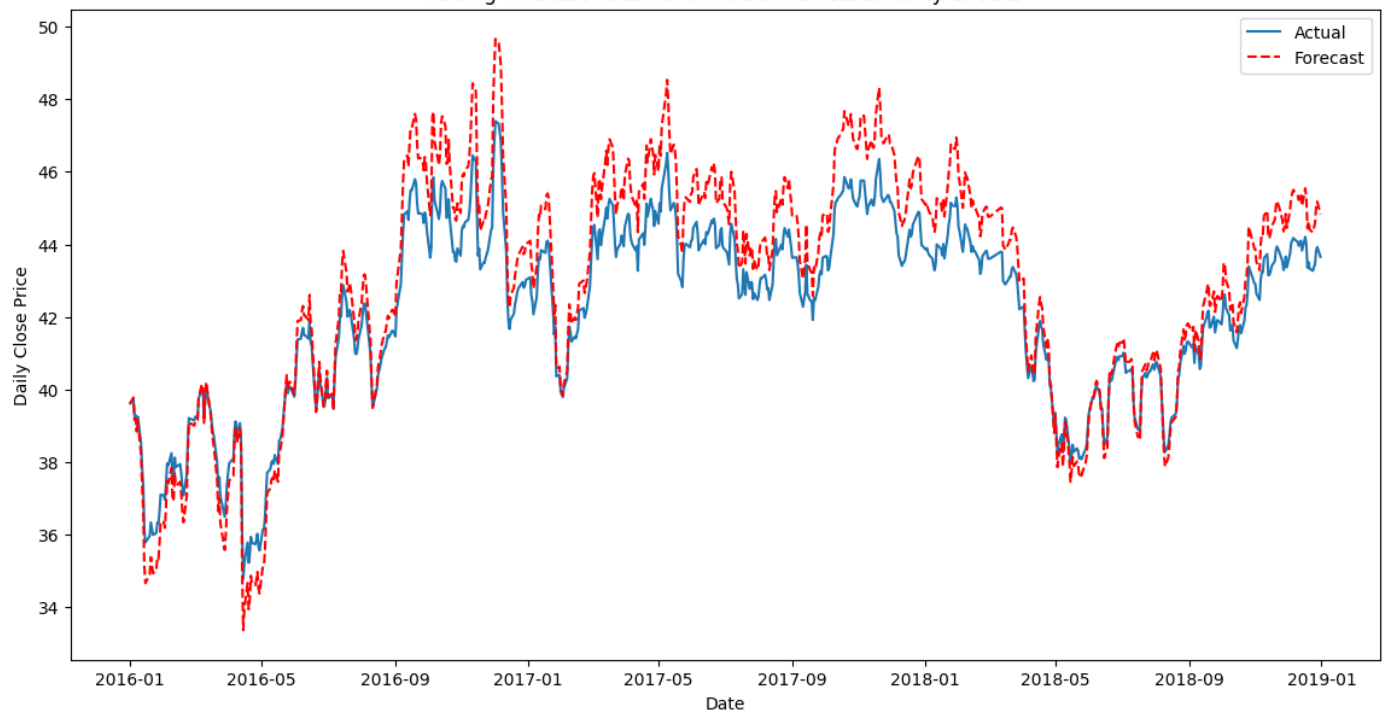
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing amzn...
Performing stepwise search to minimize aic
 ARIMA(2,2,2)(0,0,0)[0] intercept   : AIC=inf, Time=2.81 sec
 ARIMA(0,2,0)(0,0,0)[0] intercept   : AIC=25385.127, Time=0.06 sec
 ARIMA(1,2,0)(0,0,0)[0] intercept   : AIC=24730.283, Time=0.16 sec
 ARIMA(0,2,1)(0,0,0)[0] intercept   : AIC=inf, Time=1.47 sec
 ARIMA(0,2,0)(0,0,0)[0]             : AIC=25383.127, Time=0.05 sec
 ARIMA(2,2,0)(0,0,0)[0] intercept   : AIC=24304.596, Time=0.21 sec
 ARIMA(3,2,0)(0,0,0)[0] intercept   : AIC=24130.574, Time=0.28 sec
 ARIMA(4,2,0)(0,0,0)[0] intercept   : AIC=23967.854, Time=0.39 sec
 ARIMA(5,2,0)(0,0,0)[0] intercept   : AIC=23849.676, Time=0.49 sec
 ARIMA(5,2,1)(0,0,0)[0] intercept   : AIC=inf, Time=4.48 sec
 ARIMA(4,2,1)(0,0,0)[0] intercept   : AIC=inf, Time=2.98 sec
 ARIMA(5,2,0)(0,0,0)[0]             : AIC=23847.681, Time=0.24 sec
 ARIMA(4,2,0)(0,0,0)[0]             : AIC=23965.858, Time=0.20 sec
 ARIMA(5,2,1)(0,0,0)[0]             : AIC=inf, Time=1.58 sec
 ARIMA(4,2,1)(0,0,0)[0]             : AIC=inf, Time=1.41 sec

Best model:  ARIMA(5,2,0)(0,0,0)[0]
Total fit time: 16.814 seconds
Best ARIMA model: (5, 2, 0)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\amzn\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\amzn\predictions.csv
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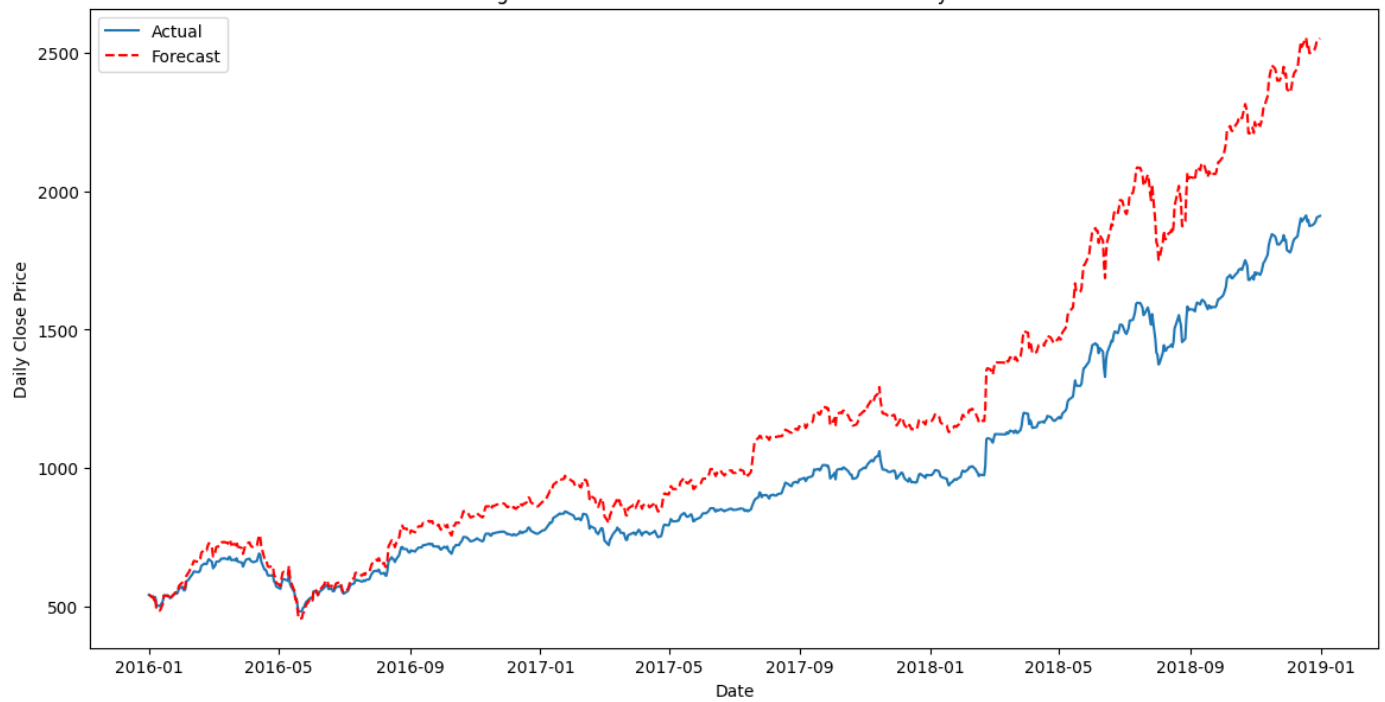
Rolling Forecast AutoARIMA Model with Stationarity Checks

```
Processing jnj...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=5940.930, Time=0.68 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=6084.016, Time=0.19 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=5936.002, Time=0.17 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=5937.220, Time=0.27 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=6083.228, Time=0.09 sec
 ARIMA(2,1,0)(0,0,0)[0] intercept   : AIC=5937.646, Time=0.25 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=5937.586, Time=0.95 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=5939.267, Time=1.10 sec
 ARIMA(1,1,0)(0,0,0)[0]             : AIC=5934.861, Time=0.09 sec
 ARIMA(2,1,0)(0,0,0)[0]             : AIC=5936.520, Time=0.17 sec
 ARIMA(1,1,1)(0,0,0)[0]             : AIC=5936.465, Time=0.12 sec
 ARIMA(0,1,1)(0,0,0)[0]             : AIC=5936.134, Time=0.10 sec
 ARIMA(2,1,1)(0,0,0)[0]             : AIC=5938.423, Time=0.23 sec

Best model:  ARIMA(1,1,0)(0,0,0)[0]
Total fit time: 4.426 seconds
Best ARIMA model: (1, 1, 0)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\jnj\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\jnj\predictions.csv
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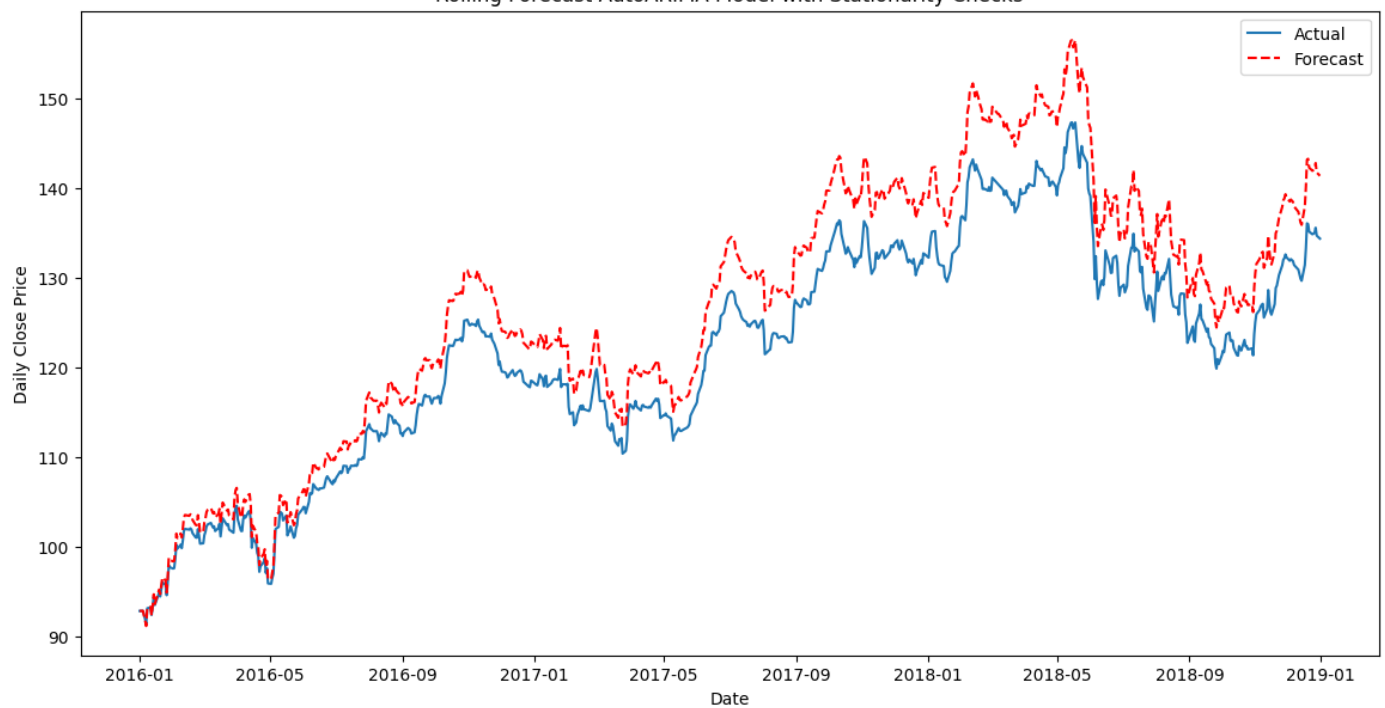
Rolling Forecast AutoARIMA Model with Stationarity Checks


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Processing jpm...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=7502.302, Time=2.37 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=7794.888, Time=0.23 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=7511.561, Time=0.22 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=7533.729, Time=0.28 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=7793.342, Time=0.07 sec
 ARIMA(1,1,2)(0,0,0)[0] intercept   : AIC=7513.168, Time=0.81 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=7515.556, Time=0.64 sec
 ARIMA(3,1,2)(0,0,0)[0] intercept   : AIC=7486.398, Time=3.05 sec
 ARIMA(3,1,1)(0,0,0)[0] intercept   : AIC=7513.315, Time=1.08 sec
 ARIMA(4,1,2)(0,0,0)[0] intercept   : AIC=7486.663, Time=3.77 sec
 ARIMA(3,1,3)(0,0,0)[0] intercept   : AIC=7487.633, Time=4.08 sec
 ARIMA(2,1,3)(0,0,0)[0] intercept   : AIC=7484.324, Time=2.47 sec
 ARIMA(1,1,3)(0,0,0)[0] intercept   : AIC=7520.979, Time=0.93 sec
 ARIMA(2,1,4)(0,0,0)[0] intercept   : AIC=7486.207, Time=3.77 sec
 ARIMA(1,1,4)(0,0,0)[0] intercept   : AIC=7502.289, Time=2.87 sec
 ARIMA(3,1,4)(0,0,0)[0] intercept   : AIC=7487.068, Time=4.39 sec
 ARIMA(2,1,3)(0,0,0)[0]             : AIC=7482.654, Time=0.94 sec
 ARIMA(1,1,3)(0,0,0)[0]             : AIC=7519.275, Time=0.28 sec
 ARIMA(2,1,2)(0,0,0)[0]             : AIC=7500.663, Time=0.76 sec
 ARIMA(3,1,3)(0,0,0)[0]             : AIC=7484.488, Time=2.43 sec
 ARIMA(2,1,4)(0,0,0)[0]             : AIC=7484.534, Time=1.92 sec
 ARIMA(1,1,2)(0,0,0)[0]             : AIC=7511.442, Time=0.43 sec
 ARIMA(1,1,4)(0,0,0)[0]             : AIC=7500.704, Time=0.88 sec
 ARIMA(3,1,2)(0,0,0)[0]             : AIC=7483.104, Time=1.63 sec
 ARIMA(3,1,4)(0,0,0)[0]             : AIC=7481.132, Time=2.41 sec
 ARIMA(4,1,4)(0,0,0)[0]             : AIC=7483.151, Time=2.41 sec
 ARIMA(3,1,5)(0,0,0)[0]             : AIC=7482.763, Time=2.65 sec
 ARIMA(2,1,5)(0,0,0)[0]             : AIC=7494.179, Time=2.45 sec
 ARIMA(4,1,3)(0,0,0)[0]             : AIC=7494.840, Time=2.10 sec
 ARIMA(4,1,5)(0,0,0)[0]             : AIC=7475.063, Time=3.05 sec
 ARIMA(5,1,5)(0,0,0)[0]             : AIC=7466.799, Time=3.47 sec
 ARIMA(5,1,4)(0,0,0)[0]             : AIC=7486.338, Time=2.70 sec
 ARIMA(5,1,5)(0,0,0)[0] intercept   : AIC=7486.477, Time=6.40 sec

Best model:  ARIMA(5,1,5)(0,0,0)[0]
Total fit time: 67.972 seconds
Best ARIMA model: (5, 1, 5)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\jpm\arima_model.pkl
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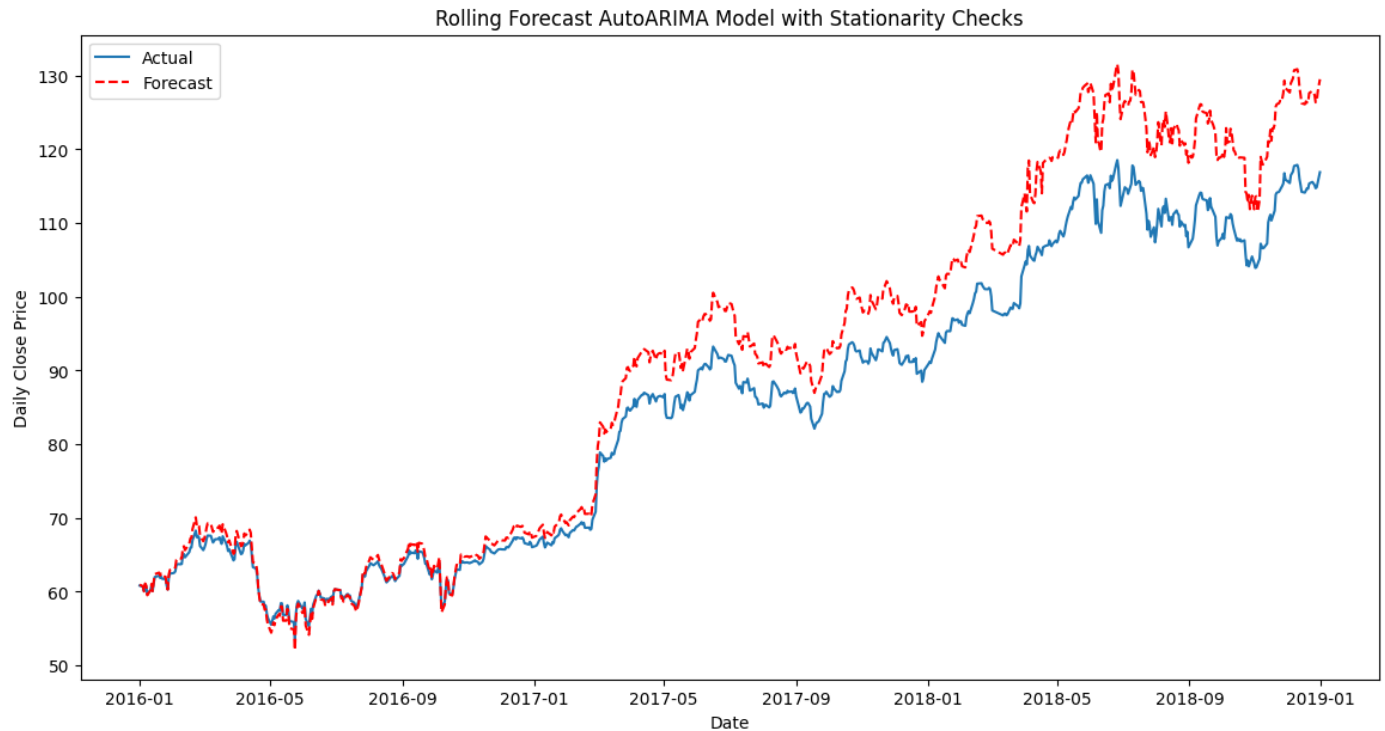
Rolling Forecast AutoARIMA Model with Stationarity Checks


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Processing ko...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=-2221.837, Time=0.49 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=-1970.488, Time=0.21 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=-2225.228, Time=0.46 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=-2206.518, Time=0.28 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=-1971.339, Time=0.24 sec
 ARIMA(2,1,0)(0,0,0)[0] intercept   : AIC=-2225.070, Time=0.19 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=-2225.282, Time=0.24 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=-2222.224, Time=0.83 sec
 ARIMA(1,1,2)(0,0,0)[0] intercept   : AIC=-2223.732, Time=0.53 sec
 ARIMA(0,1,2)(0,0,0)[0] intercept   : AIC=-2221.235, Time=1.50 sec
 ARIMA(1,1,1)(0,0,0)[0]             : AIC=-2226.595, Time=0.10 sec
 ARIMA(0,1,1)(0,0,0)[0]             : AIC=-2207.699, Time=0.10 sec
 ARIMA(1,1,0)(0,0,0)[0]             : AIC=-2226.506, Time=0.30 sec
 ARIMA(2,1,1)(0,0,0)[0]             : AIC=-2224.920, Time=0.56 sec
 ARIMA(1,1,2)(0,0,0)[0]             : AIC=-2225.059, Time=0.22 sec
 ARIMA(0,1,2)(0,0,0)[0]             : AIC=-2222.499, Time=0.19 sec
 ARIMA(2,1,0)(0,0,0)[0]             : AIC=-2226.378, Time=0.17 sec
 ARIMA(2,1,2)(0,0,0)[0]             : AIC=-2223.164, Time=0.24 sec

Best model:  ARIMA(1,1,1)(0,0,0)[0]
Total fit time: 6.874 seconds
Best ARIMA model: (1, 1, 1)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\ko\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\ko\predictions.csv
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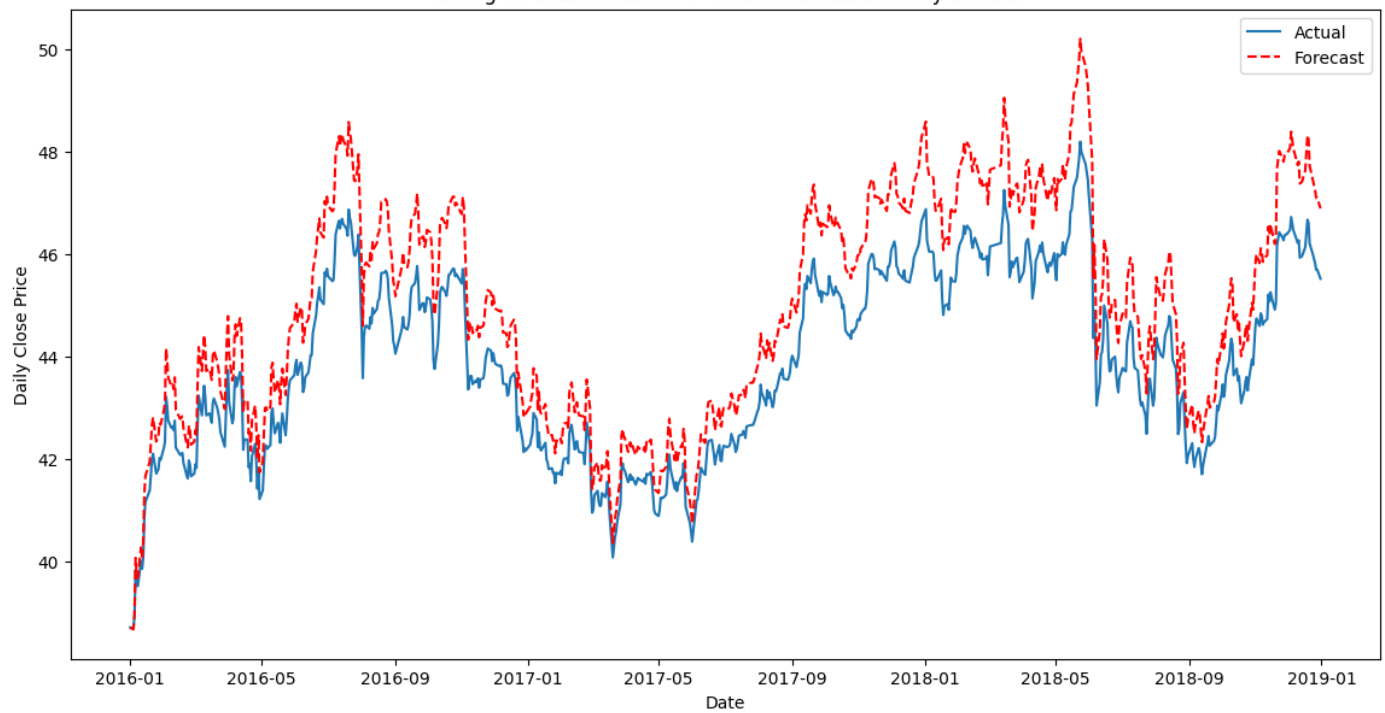
Rolling Forecast AutoARIMA Model with Stationarity Checks

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Processing mmm...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=10192.514, Time=1.31 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=10486.085, Time=0.36 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=10192.656, Time=0.15 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=10198.112, Time=0.26 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=10486.778, Time=0.06 sec
 ARIMA(1,1,2)(0,0,0)[0] intercept   : AIC=10193.812, Time=0.73 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=10192.317, Time=1.17 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=10193.722, Time=0.51 sec
 ARIMA(2,1,0)(0,0,0)[0] intercept   : AIC=10193.942, Time=0.21 sec
 ARIMA(3,1,1)(0,0,0)[0] intercept   : AIC=10192.045, Time=1.01 sec
 ARIMA(3,1,0)(0,0,0)[0] intercept   : AIC=10192.309, Time=0.25 sec
 ARIMA(4,1,1)(0,0,0)[0] intercept   : AIC=10192.945, Time=0.64 sec
 ARIMA(3,1,2)(0,0,0)[0] intercept   : AIC=10192.348, Time=2.60 sec
 ARIMA(4,1,0)(0,0,0)[0] intercept   : AIC=10190.932, Time=0.30 sec
 ARIMA(5,1,0)(0,0,0)[0] intercept   : AIC=10192.929, Time=0.38 sec
 ARIMA(5,1,1)(0,0,0)[0] intercept   : AIC=10194.926, Time=0.68 sec
 ARIMA(4,1,0)(0,0,0)[0]             : AIC=10190.627, Time=0.16 sec
 ARIMA(3,1,0)(0,0,0)[0]             : AIC=10191.915, Time=0.13 sec
 ARIMA(5,1,0)(0,0,0)[0]             : AIC=10192.621, Time=0.20 sec
 ARIMA(4,1,1)(0,0,0)[0]             : AIC=10192.629, Time=0.29 sec
 ARIMA(3,1,1)(0,0,0)[0]             : AIC=10191.671, Time=0.54 sec
 ARIMA(5,1,1)(0,0,0)[0]             : AIC=10194.616, Time=0.31 sec

Best model:  ARIMA(4,1,0)(0,0,0)[0]
Total fit time: 12.266 seconds
Best ARIMA model: (4, 1, 0)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\mmm\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\mmm\predictions.csv
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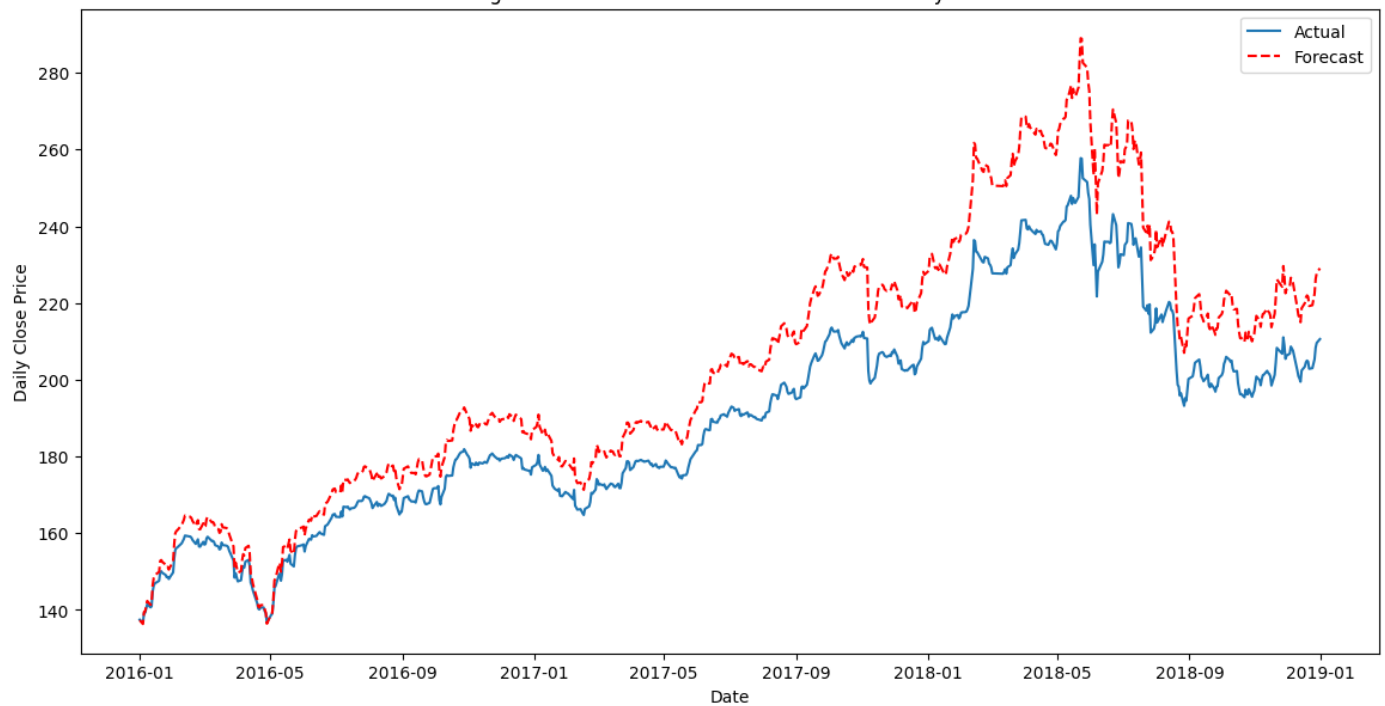
Rolling Forecast AutoARIMA Model with Stationarity Checks

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Processing msft...
Performing stepwise search to minimize aic
 ARIMA(2,1,2)(0,0,0)[0] intercept   : AIC=1412.121, Time=1.13 sec
 ARIMA(0,1,0)(0,0,0)[0] intercept   : AIC=1699.960, Time=0.56 sec
 ARIMA(1,1,0)(0,0,0)[0] intercept   : AIC=1407.932, Time=0.28 sec
 ARIMA(0,1,1)(0,0,0)[0] intercept   : AIC=1428.158, Time=0.26 sec
 ARIMA(0,1,0)(0,0,0)[0]             : AIC=1698.435, Time=0.13 sec
 ARIMA(2,1,0)(0,0,0)[0] intercept   : AIC=1408.974, Time=0.46 sec
 ARIMA(1,1,1)(0,0,0)[0] intercept   : AIC=1408.868, Time=0.60 sec
 ARIMA(2,1,1)(0,0,0)[0] intercept   : AIC=1408.637, Time=1.64 sec
 ARIMA(1,1,0)(0,0,0)[0]             : AIC=1406.235, Time=0.12 sec
 ARIMA(2,1,0)(0,0,0)[0]             : AIC=1407.269, Time=0.16 sec
 ARIMA(1,1,1)(0,0,0)[0]             : AIC=1407.161, Time=0.25 sec
 ARIMA(0,1,1)(0,0,0)[0]             : AIC=1426.501, Time=0.10 sec
 ARIMA(2,1,1)(0,0,0)[0]             : AIC=1407.145, Time=0.35 sec

Best model:  ARIMA(1,1,0)(0,0,0)[0]
Total fit time: 6.051 seconds
Best ARIMA model: (1, 1, 0)
Model saved to d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC421\cmsc421_final_project\a
gents\trained_models\msft\arima_model.pkl
Predictions and actual prices updated in d:\Personal_Folders\Tocho\UMD\spring_2024\CMSC4
21\cmsc421_final_project\agents\trained_models\msft\predictions.csv
```

Rolling Forecast AutoARIMA Model with Stationarity Checks